Patents Over Planning:
Industrial Capital and Federal Innovation Policy

by

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Submitted to the Department of Urban Studies and Planning in partial fulfillment of the requirements for the degree of

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Abstract

In recent years, scholars from a range of disciplines have analyzed the collective set of federal R&D programs as a high tech-oriented industrial policy through which the US government actively targets certain economic sectors over others for state support. Analysts have emphasized one dominant institutional feature of this system: federal R&D programs lack a central planning mechanism, and are instead highly fragmented and ad hoc. While some analysts have interpreted this institutional structure as a strength, others view the absence of R&D planning as a major shortcoming, a view shared by policymakers advocating for increased coordination of federal R&D programs in order to help combat economic and environmental challenges. This study examines the origins and institutional evolution of federal innovation policy, and in doing so, probes possibilities for future reform.

My account focuses primarily on the *business-state nexus* as an explanatory factor, emphasizing the role of politically active industrial firms in shaping the system's legal and institutional structure. I argue that R&D-based industrial firms were opposed to proposals for R&D planning, but only insofar as these proposals also threatened a separate institutional feature to which these firms were more firmly committed: the transfer of patent rights resulting from government-led R&D projects into private hands. During the New Deal and into the immediate postwar period, the link between patent reform and innovation planning prompted industrial firms to lead the attack against progressive calls for a more coordinated R&D system. When government patent policy became decoupled from planning during the Space Race and eventually led to a new consensus on "technology transfer," industrial firms shifted in favor of R&D planning but by that time saw their political influence substantially reduced. The neoliberal business coalition lobbied instead for increasingly fragmented one-off programs to promote specific high-tech fields—a "hidden developmental state" that would remain intact until the present. From this perspective, the structure of the federal R&D system is more a result of a conflict over property than over planning, and the institutional link between coordination and government patent policy may frustrate future attempts to finally realize planned innovation in the US.

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Introduction:

Industrial Policy, American Style

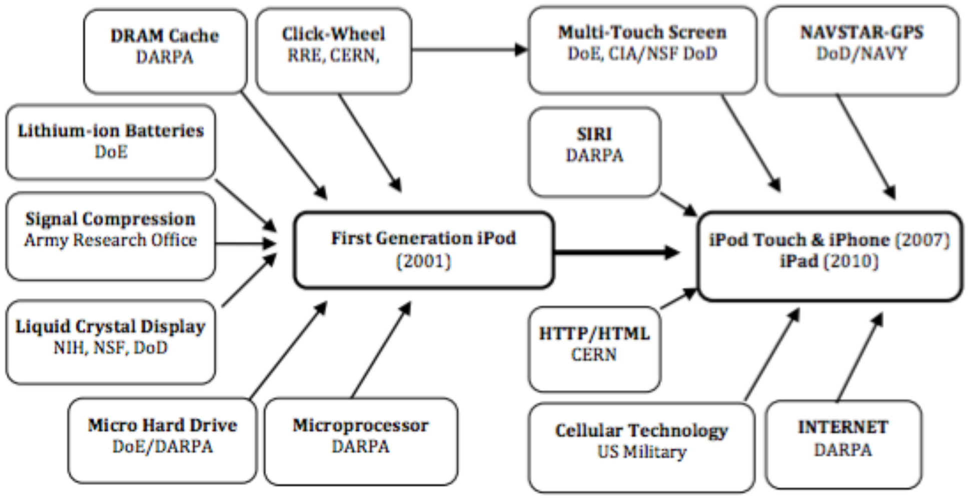
Since the rise of industrial capitalism, the American economy has been a crucible of technological innovation. Leading industrialists have long celebrated the nation's innovative capacity as a triumph of economic liberalism and of a peculiarly American entrepreneurial energy. Looking back on his success as the country's leading automotive magnate, Henry Ford celebrated "that great inventive spirit of America," and argued that if "governments would only understand that if people are left alone they'll work out their own salvation."[i] Over half a century later, the new captains of industry echo the same message. Tesla founder Elon Musk has spoken of the US as "still the land of opportunity more than any other place," emphasizing how the government steps aside and allows the private sector to drive technology development.[ii] Under this conception, American innovation grows organically from the nation's free-market-oriented political economy. Left alone by the state, inventors and entrepreneurs are able to develop radical new technologies that transform the economy.

It is a striking fact, then, that much of the technological innovation that has driven American economic development over the past several decades can be traced back to direct government intervention. Particularly since World War II, the federal government has played a foundational role in promoting technological progress through support for research and development (R&D). Federal R&D programs such as the National Science Foundation (NSF), the National Institutes of Health (NIH), the Defense Advanced Research Projects Agency (DARPA), and many others have generated technological advances that have transformed the American economy and helped maintain long-run growth. Through its vast R&D system, the government has engaged in the high-risk variety of research that the private sector cannot rationally justify, sustaining "blue sky" innovation that creates entirely new markets in new technological fields. Either by providing the technological infrastructure on which further innovations are built or by generating proto-versions of new products themselves, government support has been foundational to many of the last century's growth-generating breakthroughs. Surveying the economic history of the past century, Michael Lind concluded that

> The most innovative entrepreneur in the 20th century was the US government. The federal government invented or developed nuclear energy, computers, the Internet and the jet engine. And it built the interstate highway system and completed the national electric grid, creating a continental market based on the technologies of the second industrial revolution. To be sure, the government has sometimes backed failures, usually in the fad-driven energy field...But few private venture capitalists can match the remarkable record of success of Uncle Sam.[iii]

Though it is difficult to determine with any rigor the total economic effect of these R&D programs, there is evidence to suggest that state-led R&D has had a profound impact.[iv] One useful approach is a careful tracing of the origins of particularly important innovations. Fred Block, for example, has demonstrated that the majority of the most important new products from 1970 to 2006—as determined by *R&D Magazine's* annual innovation awards—received federal funding at some point during their development cycles from invention to commercialization.[v] In healthcare and pharmaceuticals, government support through the NIH and NSF has enabled the development and commercialization of countless drugs and some of the past century's most significant medical devices, including magnetic resonance imaging (MRI) and advanced prosthetics.[vi] The multi-decade Human Genome Project, jointly led by the Department of Energy (DoE) and the NIH, has revolutionized human genetics and led to new advances in medical practices. State-backed research has also had major impacts on the energy sector, in some cases shifting the direction of the entire industry to new sources of fuel made possible by technological breakthroughs. Advances in 3D seismic imaging supported by the DoE and Los Alamos National Laboratory have facilitated the search by oil companies for new fields, and research at the DoE's National Energy Technology Laboratory also developed the technology that enabled commercial-scale fracking and the shale gas revolution.[vii]

Perhaps the most striking case, however, is the federal government's essential role in creating the foundations of the modern information and communications technology (ICT) industry, which has been the primary driver of technology-based US economic growth for over thirty years.[viii] It is difficult to find any major ICT breakthrough in recent decades that did not at some point receive federal support. The National Aeronautics and Space Administration's (NASA) satellite system, built during the apex of Cold War technological rivalry, established the basic infrastructure necessary for global communication networks. By the late 1970s the Department of Defense (DoD) would use these satellites to develop the first functional Global Positioning System (GPS). DARPA's "ARPANET," an experimental program that began in the early 1960s, would lay the groundwork for the modern Internet and all its associated developments. Larry Page and Sergey Brin's Google began with a $4.5 million grant from the NSF's Digital Library Initiative, long before venture capital allowed the two to scale up and commercialize their project.[ix] Even Apple, supposedly the brainchild of a visionary entrepreneur and now the world's largest publicly traded company, bears the state's imprint on many of its flagship products. As Mariana Mazzucato has shown, nearly all the major components of Apple's iPhone—along with its earlier iterations as the iPod—emerged from government-backed innovations a generation earlier, particularly those led by the DoD and DoE:



[x]

By the time products like the iPhone are fully developed and commercialized, of course, they are under the control of private actors in the market. Consumers encounter these innovations as the result only of private activity—they see the handiwork of the Henry Fords and Elons Musks, but not the critical contributions of the state. The government's role in technology development is therefore a "hidden" fact of the American economy that conflicts with the nation's foundational economic narrative.[xi] Mazzucato thus concluded that

> the United States is not what it seems. The preacher of the small State, free-market doctrine has for decades been directing large public investment programs in technology and innovation that underlie its past and current economic success. From the Internet to biotech and even shale gas, the US State has been the key driver of innovation-led growth—willing to invest in the most uncertain phase of the innovation cycle and let business hop on for the easier ride down the way.[xii]

This dissertation examines this strange feature of American political economy and probes its institutional origins. It seeks to understand how the modern federal R&D system came into being during and immediately after World War II, and why this vast state capacity for technology development took on its ultimate form in the decades that followed. In doing so, it emphasizes the critical role of one major interest group that participated in and benefited from this system—R&D-

intensive industrial firms—in shaping the contours of federal R&D programs and influencing key policy choices. As this dissertation aims to demonstrate, the institutional structure of federal innovation policy is the result, as least in major part, of the self-identified interests, policy preferences, and political activities of industrial capital.

I begin this introduction with an overview of the federal R&D system's institutional structure, focusing on the decentralized and fragmented quality to which many analysts have pointed, and present the basic research question this study aims to answer. I then briefly discuss the recent intellectual revival of industrial policy in the US—and with it, ideas for reforming the federal R&D system—and how this new context provides motivation for this study. I then review the existing explanatory frameworks for federal innovation policy's structure and propose the alternative pursued in this dissertation: the business-state nexus and the specific role of industrial firms. I discuss why this framework is a particularly good fit for questions of American political economy, and I describe how this framework can be applied to federal innovation policy by tracking the activities of the National Association of Manufacturers, the leading voice of industrial capital for the better part of the century. I then provide a brief overview of the dissertation's central argument and lay out the plan for subsequent chapters.

Innovation Unplanned

In recent years, scholars from a range of disciplines have analyzed the collective set of federal R&D programs as a high tech-oriented industrial policy—alternatively, an *innovation policy*—in which the government actively targets certain economic sectors over others for state support. This mode of analysis that frames federal R&D programs as a peculiar American version of industrial policy draws on the extensive literature on industrial development planning and state capacity in rapidly developing countries. While industrial policy and sectoral planning were core concerns of postwar developmentalist thinkers, the more contemporary literature on industrial policy originated with analyses of successful postwar catch-up experiences, chiefly those of East Asia.[xiii] Scholars of industrial policy sought to demonstrate that the role of the state was critical to the industrial transformations of East Asian countries—a counter-attack on the emerging "Washington Consensus"—with state-led promotion of particular sectors as the determinative area of policy. For example, in her analysis of South Korean developmentalism, Alice Amsden focused on the ways in which the South Korean state directly intervened at the firm level to increase productivity and create "national champions" capable of competing with the most productive firms on the global market.[xiv] Robert Wade identified similar behavior on the part of the Taiwanese state, which nurtured manufacturing and high-tech industry through careful promotion and R&D policies.[xv]

The American federal R&D system is, of course, quite different from these classic "developmental states." While the planning apparatus of the South Korean state acted as a harsh "disciplinarian" of underperforming firms, for example, federal innovation policy in the US prefers only the carrot, offering participating firms subsidies in the form of grants and intellectual property. There are several common features, however: both types of industrial policy are forms of state activity aimed at altering the production structure of the economy, often in ways contrary to what prevailing market forces dictate. Many of the theoretical justifications put forward by advocates of American innovation policy are similar to those identified by analysts of industrial policy in developing countries: for both industrial policy "at the frontier" in the US and industrial policy for catch-up elsewhere, the theoretical point of departure is often some version of market failure.[xvi] Both types of industrial policy depend on similar state capacities to be carried out effectively, requiring well-trained and politically insulated bureaucrats to implement policy. These similarities have led some analysts of industrial policy to make no distinction between the two.

In one critical respect, however, postwar American innovation policy differs dramatically from the industrial policy of South Korea, Taiwan, and others: it is *unplanned*. Unlike the classic developmental states, the federal R&D system is not centralized and the various programs within it do not adhere to a cohesive long-term plan for research and technological advance. Analysts of the system have emphasized this dominant institutional feature: federal R&D programs are highly decentralized, fragmented, and thus largely "hidden" from public scrutiny and debate.[xvii] Each agency within the vast array of federal innovation programs has its own unique mandate and budget, and these agencies often actually compete with each other for resources rather than work collaboratively toward a larger goal. There are no American "Five Year Plans" for research and technology. While there are some long-standing central science and research advising capacities based in the White House—embedded primarily in the Office of Science and Technology Policy (OSTP)—they remain purely advisory and have minimal leverage over the actual budgets and goals of the various R&D agencies. This has lent a certain *ad hoc* quality to the innovation system: while federal R&D programs do target certain industries, they do so largely as a result of the vicissitudes of federal funding battles and not of a central planning mechanism.

What separates the federal innovation system from East Asian-style developmentalism, then, is the absence of both a planner—usually a key central agency with a Weberian structure—and a plan. In his review of the history of US industrial policy, Todd Tucker usefully distinguished industrial policy, which he framed as any *de facto* targeting of certain economic sectors over others, from "industrial planning," defined as "an intentional economy-wide aggregation of and coordination among individual industrial policies."[xviii] Following Tucker, we can say that the federal R&D system as it is currently constituted is a mechanism of industrial policy but not industrial planning. Without an "intentionality" guiding the overall direction and goals of innovation policy, the decentralized "hidden developmental state," in Block's terminology, targets certain technological fields for support in a more improvised manner. Decentralized and institutionally separate R&D programs act in pursuit of their own distinct goals and not in accordance with a larger technological vision.

Some observers view this fragmented structure as a boon to innovation. Block, for example, believes the improvisational character of the federal R&D system is well-suited to how innovation actually occurs:

> The most important feature of this system is that high levels of initiative are left to actors on a widely dispersed basis in recognition that overcoming technological barriers cannot be centrally directed. As with science itself, the core idea is that progress is likely to be greatest if different teams of technologists working in different locations have the freedom to experiment with different ways to solve technological puzzles.[xix]

While this structure might result in occasional redundancies—with multiple R&D agencies working to solve the same problem—Block maintains that this maximizes the chances of success: these overlaps "increase the chances that somebody with an unorthodox but promising idea will have a chance to persuade some funding agency to support his or her efforts."[xx] Building on Block's arguments, Andrew Schrank and Josh Whitford view the decentralized structure of the federal R&D system as an apt response to the decentralization of innovation and production itself. Innovation, according to Schrank and Whitford, now emerges gradually from "networks" rather than particular firms at particular times, and the fragmented R&D system can aid in facilitating this kind of network-based invention.[xxi] Block, Schrank, and Whitford add to this a political argument. In the neoliberal era, any form of highly visible state intervention is likely to come under conservative attack, and so decentralized, "hidden" forms of developmentalism such as those embedded in the R&D system have a better chance of withstanding these attacks.[xxii] This perspective is discussed further in the section below.

While other observers generally agree that some level of decentralization and agency-specific initiative is desirable, they also see advantages to a more centralized and planned system and have called for reforms to that end. Robert Wade, the leading analyst of developmental Taiwan, suggests:

> In terms of organizations, having a rich array of horizontal and vertical networks is necessary but not sufficient. Notwithstanding the political advantages of having no industrial policy centre, it would be desirable to coordinate the various federal agency programmes more than at present by establishing a central agency near the top of government.[xxiii]

Others agree on the need for some kind of central institutional body that would establish a greater level of coherence in the national R&D effort. Michael Lind has called for a centralized federal R&D bank to implement a national innovation plan and to "replace the historic role of the military in funding American innovation."[xxiv] Jonathan Gruber and Simon Johnson suggest a federal "Innovation Commission" that would take stock of the R&D capacities across the country and develop plans for a new national program for spreading research-based economic growth geographically.[xxv] The point of distinction here is that if the federal government is interested in pursuing *specific* developmental goals through R&D—for example, promoting specific technologies or allocating their economic benefits more equitably—it may have to reorganize the various R&D agencies to some degree and achieve some new level of coordination. The hidden strengths that Block and his colleagues emphasize may accelerate the rate of innovation *in the* *aggregate*, but they do not generally help in the pursuit of more specific technological aims. For those, the government must engage in some form of coordinated R&D planning.

These questions are no longer limited to academic debate. The past two years have seen a surprising revival of industrial policy among prominent politicians and DC policy circles, with the federal R&D system noted as a key lever of sectoral targeting that could be used in such a policy. This resurgence spans much of the political spectrum. Breaking with forty years of neoliberal orthodoxy, some conservative figures have endorsed an industrial policy and a more centralized and coherent R&D system as a means of staving off Chinese competition in high-tech fields.[xxvi] Fears of a technologically dominant China have caused some conservative think tanks to drop their allegiance to Reaganomics and advocate for growth-oriented planning in nationalistic terms.[xxvii] Hoping to stave off prolonged secular stagnation, some Democrats have cast an expanded and reformed federal R&D system as the key to reviving the higher growth rates of the 1990s and the postwar Golden Age. Progressive groups, meanwhile, have begun to repurpose industrial policy for the specific goal of transitioning the American industrial base toward green and sustainable technologies. The drumbeat led by Alexandria Ocasio-Cortez, Bernie Sanders, and other progressive Democrats for a "Green New Deal" is essentially an advocacy campaign for a green industrial policy, with some policymakers and think tanks explicitly noting this connection.[xxviii] In this new political context, the warnings of Block and his colleagues about the dangers of policy visibility may no longer apply. Conversely, a more centralized—and thus more visible—innovation policy may be necessary to rally the required political support for any program of this scale.

Importantly, each of these camps has called for some degree of centralization and planning of the nation's R&D capacities in one form or another. Elizabeth Warren, for example, called during the Democratic Primary for a "Green Industrial Policy" plan that would centralize the federal government's R&D activities within a new "Department of Economic Development" and implement 5-year R&D plans. Marco Rubio and the Senate Small Business Committee advocate for a similar independent agency run through the White House. In perhaps the most ambitious plan put forward to date, Democratic senators have submitted the "Endless Frontier Act"—an ode to the leading architect of the postwar innovation system, Vannevar Bush—which would scale up federal R&D funding dramatically and give the National Science Foundation (to be renamed the National Science and Technology Foundation) a broadened mandate to plan technology development and target certain industries for support. The conclusion of this dissertation will return to these recent developments. For now, it is important only to note that major reforms to the R&D system—several of which would move the system in a more centralized direction—are on offer and are being taken seriously.

In light of these new debates over the structure of federal innovation policy, it is an opportune moment to examine the origins of that structure. This study thus examines the institutional and legal history of federal innovation policy, and in doing so, probes possibilities for future reform. Specifically, this dissertation asks why the federal R&D system developed in a form that is decentralized, fragmented, and ad hoc, and why a more centralized and planned innovation policy has never been adopted. Understanding how a policy domain can be shifted in a certain direction requires some reliable framework that explains its historical origins and the set of interests that may be sustaining it in its current form. In doing so, this study uses a new analytical framework that differs from those offered in the existing literature. Before detailing what this framework is and how it sheds new light on federal R&D's institutional structure, the discussion first lays out these already-existing frameworks. Contemporary accounts of federal industrial policy mainly fall into three categories, each with a separate set of framing assumptions and points of emphasis, and each carrying different implications for how industrial policy might be reformed. I describe each of these frameworks here, along with some of their limitations.

1. Neo-Polanyian

As noted above, Block and other economic sociologists who see the decentralized structure of the innovation system as a strength have interpreted the system within a Polanyian framework.[xxix] They propose that contemporary forms of industrial policy are part of a "counter-movement" of social protection against expanding market forces, which is why their focus is primarily on programs during and after the rise of market fundamentalism in the 1980s. In their narrative, market expansion led to "network failures" in the form of highly fragmented and disjointed social networks between different actors in the innovation process. The form of social protection that the neo-Polanyians focus on, therefore, are primarily those that serve to "broker" interactions between disconnected actors and in doing so, patch up market-generated network failures that can slow innovation. For the neo-Polanyians, and for Block in particular, industrial policy is characterized as "hidden" from active government oversight and from the public discourse more generally because the practice of industrial policy by the federal government fundamentally conflicts with liberal market ideology that they believe to be the dominant constraining factor. It is in this sense that federal industrial policy "swims against the current" of neoliberal political discourse.[xxx]

While it can shed some light on policy debates after the rise of neoliberalism, this perspective offers an incomplete picture of the R&D system's full development since WWII. The neo-Polanyian account does not fit the broader historical trajectory from well before the 1980s: it does not, for example, explain the rise of state-led technology development programs during and immediately after WWII, a period of relatively well-regulated capitalism in the US. This framework also lacks a clear account of the sources of power and agency in this story. Block, for example, details the establishment of different industrial policy programs but does not offer an explanation for why those particular programs were chosen and who they benefit most directly. Finally, the characterization of modern innovation policy as part of the Polanyian countermovement is somewhat odd. Federal R&D programs in the US are designed to quicken the pace of technological change, which would seem to play the opposite role of a countermovement geared toward protecting people and institutions from the market's most disruptive effects. If anything, the expansion of industrial policy in the 1980s would represent the expansion of markets through the creation of entirely new technologies.

The neo-Polanyians may err in their portrayal of industrial policy as a countermovement because they are committed to a conception of neoliberalism broadly as a *contraction* of the state. If neoliberalism is understood in this way, then the creation of the "extended pipeline" of R&D support in the 1980s does indeed seem paradoxical and "against the current." But if, on the other hand, neoliberalism is better thought of not as a contraction of the state writ large but instead as an effort to shield certain functions of economic policymaking from democratic control, as new historical work has contended,[xxxi] then the extension of industrial policy programs in the 1980s fits well within this broader trend, since a central planning mechanism might plausibly be a more visible and thus more openly debated state activity. The alternative framework that this study develops will show that the new hidden developmental state in the US actually swam *with* the neoliberal current and not against it. Chapter 4 takes up these issues directly.

2. *Military Exceptionalist*

A different perspective has been put forward by Linda Weiss, who suggests that federal innovation policy is primarily an artifact of American military supremacy. Pointing to the fact that the most influential R&D programs are directly linked to the "National Security State" (NSS)—DARPA, for example—Weiss suggests that the US practices innovation policy only to serve its military prerogatives, and any broader effect of these programs on the American economy is largely incidental. The American developmental state is "hidden" not because it conflicts with free market ideology, *a la* Block, but because it services a military-industrial complex that needs to remain hidden in order to survive and expand.[xxxii] Moreover, according to Weiss, there are no internal features of the American state that prevent it from sustaining coordination-based innovation policy; the shortcoming is rather the lack of political will to extend the NSS's innovative capacity to other technological domains.[xxxiii]

It is certainly true that many of the federal government's technology development programs are situated within the NSS, but Weiss' framework cannot explain a number of features of innovation policy since WWII, including federal support for non-military technologies even immediately after WWII—for example, the dramatic expansion of the NIH in the postwar decades—and the increased "civilianization" of many programs that originated from within the NSS beginning in the late 1970s. While the largest share of federal R&D spending is still doled out from the DoD, there are myriad non-military programs spread across the federal government that have a massive impact on technology development. These include major agencies such as the NIH, NSF, and NASA, as well as a host of smaller technology-specific programs like Manufacturing USA, ARPA-Energy, and others. Moreover, Weiss' account does not explain the actual institutional structure of federal innovation policy; it does not, for example, show why technology development programs situated within the NSS are themselves fragmented rather than centralized and coordinated. Weiss' framework is perhaps a useful account of one major arm of federal innovation policy—the technology programs of the NSS—but does not provide explanations for some of its basic features on the whole.

3. State Structuralist

The account that most closely parallels the framework used in this study is the state structuralist framework developed by Daniel Kleinman, David Hart, and Otis Graham, among others.[xxxiv] Unlike the neo-Polanyian and military exceptionalist frameworks, these accounts do emphasize the institutional choices that led to the current structure of federal industrial policy. Their focus is primarily on the immediate postwar moment, and the policy battle between the late New Deal vision of a centralized and coordinated innovation system and Vannevar Bush's decentralized alternative. They focus, however, on struggles between various actors within and adjacent to the state and on the structural headwinds faced by advocates of centralized innovation policy. Ultimately, these analysts conclude that the failure of the federal government to develop a centralized and coordinated innovation policy resulted from *internal* characteristics of the American state, pointing in particular to the highly decentralized structure of the government itself and to the lack of programmatic and disciplined parties that could implement such a policy.

Kleinman's *Politics on the Endless Frontier*, a study of the origins of the NSF, deserves particular attention here, as it is the closest to the present study in substantive terms. Kleinman argued that the failure to turn the proto-version of the NSF into a centralized R&D planning agency—the central topic of Chapter 2 of this dissertation—was the result of structural features of the state that worked to stifle the proposals put forward by the late-New Deal advocates of research planning. Referring to Senator Harley Kilgore's efforts to establish a centralized R&D program, Kleinman observed the following:

> The permeable and fragmented character of the American state, combined with undisciplined political parties, led to one delay after another; two bills died in committee at the hands of cross-party coalitions, and one bill was vetoed by a Democratic president presented with a Republican piece of legislation...fragmentation and permeability beget further fragmentation. The delay in passage of national research policy legislation led to the construction of a fragmented matrix of science policy institutions, each with limited roles.[xxxv]

Hart came to similar conclusions in *Forged Consensus*, a detailed history of the slow emergence of the pluralistic model of innovation policy from the 1920s until the early 1950s. Focusing on "policy entrepreneurs" and their competing advocacy efforts to shape innovation policy from within the state, Hart concluded that the fragmented structure of the postwar system ultimately represented a hybrid of competing reformist frameworks. Advocates of a more coordinated and centralized research program—those from the planning-oriented traditions of pro-business "associationalism" and "reform liberalism"—lost out to the Keynesian and the national security models of R&D, the result being the fragmented modern R&D system. As for why so many competing ideas were able to influence R&D policy, Hart pointed to "the decentralized structure of American political institutions, which offers so many opportunities for policy entrepreneurship."[xxxvi] The permeability of the state thus allowed many different claims on policy making to coexist, which itself gave rise to R&D fragmentation.

The framework offered in these accounts is thus similar to state structuralist accounts developed by Theda Skocpol and others as well as the "weak state" accounts of policy outcomes in the US.[xxxvii] Since Kleinman's and Hart's studies, however, the weak state perspective on federal policy has been challenged by a number of scholars, including Block and Weiss on the innovation policy question in particular. The basic counterargument against state structuralism is that there are actually no legal barriers preventing the federal government from establishing a centralized agency with broad powers to control and coordinate innovation policy, and that the federal government has effectively created and centralized a number of regulatory functions since WWII, including environmental protection and workplace safety. Moreover, the treatments of business-state relationships in establishing the early structure of postwar industrial policy seem inadequate in light of recent work on the role of business organizations in the postwar moment. Both Kleinman and Hart do give some attention to the role of key industrial business groups in opposing a centralized research policy, but they treat these groups as just another set of voices making claims on the state, on relatively equal footing with other key interest groups.[xxxviii] The present study problematizes this framework and suggests quite the opposite: industrial business was not just one player among many in the evolution of federal innovation policy, but instead acted as the *key influence* in determining policy outcomes at certain critical junctures. If we seek a better historical understanding of the institutional structure of federal R&D, we must adopt a framework that prioritizes this factor.

Capital on the Endless Frontier

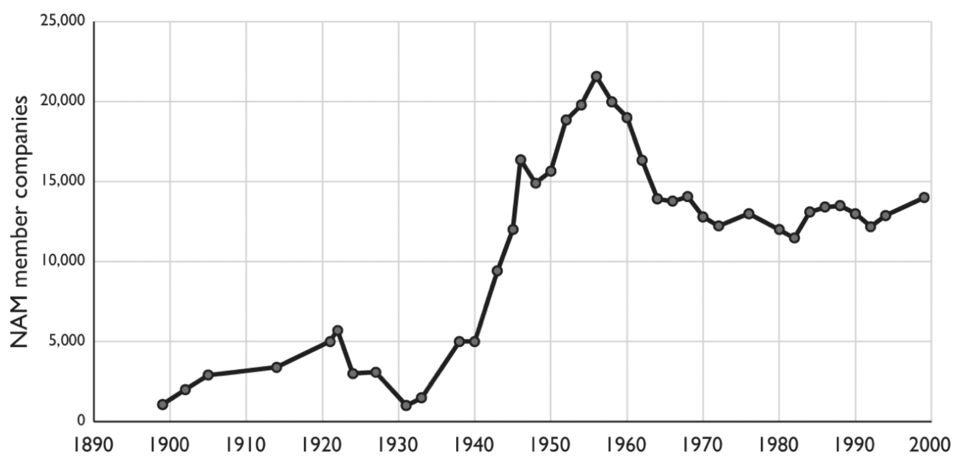
This study thus offers an alternative account that focuses primarily on the *business-state nexus* as an explanatory factor, emphasizing the role of politically active industrial firms in shaping the federal R&D system's legal and institutional structure. A basic motivation for using this framework is the emergence of new scholarship in the past decade that has sought to revisit and further illuminate the dominant role of business organizations in American society since the Second World War. Scholarship on the relationship between American business and the state—what might broadly be termed *American Political Economy*—has returned to prominence following the Great Recession and increased political disaffection with the neoliberal order.

This new scholarship on business organizations in the postwar period draws on several strands of work on political, legal, and business history in the US. The first of these is the "progressive school" originating during the interwar period, which introduced a "people-versus-business" dualism into American historical thought by detailing the ways in which powerful corporate leaders opposed efforts of early progressive-era leaders to reform American capitalism.[xxxix] This framework would be extended in the decades that followed by liberal historians such as Arthur Schlesinger Jr., who highlighted the extreme resistance to the New Deal on the part of the business class.[xl] In the postwar decades of relative industrial peace and widespread improvements in living standards, the progressive framework would be challenged by a new school of thought that suggested that the most powerful elements of the national business class had basically accepted the New Deal and the new roles for the modern state that it had generated. This framework of "corporate liberalism" portrayed business not as an inevitable adversary of all reforms but as a potential and sometimes willing partner in moderate policy making.[xli] Following the neoliberal turn in American politics, the corporate liberal framework has fallen out of favor to some degree.

The more recent literature has offered a more nuanced synthesis of these multiple strands of business-state analysis. While American business has often and with respect to particular policy issues been highly reactionary, acting aggressively to overturn liberal and progressive reforms, it has at other times been accommodating of certain features of the postwar state and even sought the expansion of these features. Moreover, business attitudes and political positions have not been automatically determined, static, and fixed; scholarship has shown that business has frequently taken time to figure out how to position itself on certain issues, and has often changed its position as new developments occur. Finally, American business has rarely been wholly unified, and there have nearly always been divisions between different sectors and firms of different sizes. What defines much of this work has been a focus on key networks and business groups. Kim Phillips-Fein, for example, has chronicled how the most reactionary segments of the national business class, including the DuPont-led Liberty League and others, worked tirelessly through the postwar Keynesian consensus years to overturn New Deal reforms, finally achieving many of their goals at the onset of the Reagan Revolution.[xlii] Charlie Whitham, in contrast, has highlighted the key role of the "Corporate Moderates" and their business organizations (The Committee for Economic Development, Twentieth Century Fund, and National Planning Association) in supporting and indeed actively shaping national policy making in the 1950s and 60s, thereby staving off the conservative counter-reaction that would come later.[xliii] Mark Mizruchi has come to similar conclusions, finding that the national business class during this period was highly organized and ideologically coherent compared to earlier and later periods, and it was this organizational coherence that lent business its streak of moderation.[xliv]

Of the multiple business organizations that helped determine the course of postwar American political economy, one was particularly close to the issues involved in the federal R&D system and the institutional choices that were made during the course of its evolution. The National Association of Manufacturers (NAM) was, and to a large extent still is, the leading industrial business organization in the country and a major determinant of the many policy decisions that impact manufacturing firms. Founded in the 1890s in response to the rise of the American union movement, NAM was the first national business organization (preceding the Chamber of Commerce by two decades) and focused overwhelmingly during its initial decades on preserving a single institution: the open shop. During the New Deal, NAM opposed many of Roosevelt's reforms—particularly those that threatened the open shop, such as the Wagner Act, as Chapter 1 will discuss. However, the Association soon became ideologically flexible, and began to engage with subtle policy choices impacting the contours of the American state—federal R&D programs being a key example—in a way that other conservative business organizations such as the Liberty League and Chamber of Commerce avoided. With this new pragmatic openness toward certain policy questions came a marked increase in NAM's political influence.

Jennifer Delton captures this shift and its major political consequences in *The Industrialists*, her recent comprehensive history of NAM from its founding up to the 1980s.[xlv] Delton makes the case that, despite being overlooked by earlier generations of business history scholars, NAM was likely one of the most influential business organizations over national policymaking in the 20th Century, and certainly the most influential with respect to policies impacting the manufacturing sector. Following the manufacturing boom triggered by the American entry into World War II, NAM's influence over national affairs peaked in the late 1940s, when the Association played the critical lobbying role in pushing forward the Taft-Hartley Act. During this period NAM also saw its membership numbers soar, declining again only by the late 1950s:



[xlvi]

Aside from its continued assault on the Wagner Act, however, NAM increasingly sought cooperation with the liberal postwar state after WWII, a positioning that allowed it to maintain its influence over national policy making. This included a deep engagement with the emerging federal R&D system. Through the lobbying and public relations activities of its various R&D-oriented committees—primarily the Patents and Research Committee, later restructured as the Research Committee and then Technology Committee—NAM carefully monitored the explosion of large-scale state-backed R&D during the Second World War and the new state institutional forms that were emerging. These committees included the largest and most influential industrial firms in the nation, many of which had themselves pioneered the very practice of rationalized corporate R&D in the preceding decades. Committee members such as DuPont, General Electric, General Motors, Procter and Gamble, and others had long relied on major in-house R&D capacity to maintain their technological advantage, and became deeply engaged with the policy questions raised by the government's newly prominent role in directly supporting R&D. These firms were soon joined by a new set of higher-tech industrial giants that now counted on research partnerships with the state as a core feature of their business models: these included Boeing, Lockheed, Sperry Gyroscope, and even early ICT sector leaders like IBM.

For these firms, R&D was a critical determinant of profit. R&D-intensive industrial firms relied on advances made in their corporate laboratories to maintain competitive edge in existing markets and to create entirely new ones. As David Noble argued nearly fifty years ago in his history of the rise of corporate R&D, it is impossible to divorce American science and research from the profit drive of the nation's most technologically advanced firms.[xlvii] The centrality of research to these firms' strategies and profit margins led, often through subtle mechanisms, to a "corporatization" of science embedded across various institutions, including the university system. Alfred Chandler likewise contended that the development of corporate research was a critical input in the rise of "Big Business" in the late 19th Century, and helped usher in the "Second Industrial

Revolution."[xlviii] Viewed in this light, the emergence of large-scale public R&D during and immediately after WWII was one of the most important innovations in economic policy institutions of 20th Century America—perhaps nearly on par with the founding of the Federal Reserve or the creation of the Bretton Woods system. The government's new role as the leading promoter and coordinator of research radically altered the landscape in which firms at the technological frontier––which served as the prime motor for the country's long-run economic growth—conducted their operations. R&D-intensive firms were now embedded in a complex set of state research institutions; they worried about the rise of public R&D, and its potential incursions into private decision making and property, at the same time that they came to rely on it.

This analysis of the origins of the structure of federal innovation policy thus puts industrial firms front and center. It focuses primarily on the role of NAM, the country's leading advocacy group of R&D-oriented industrial firms, as the key business voice during the moments of institutional renovation of the R&D system. The basic hypothesis set up by this framework suggests that the ultimate structure of the innovation system is, at least in large part, some reflection of the interests of industrial business over the course of the system's emergence and gradual evolution. The table below summarizes how this framework and its corresponding hypothesized account and materials for analysis differ from those of the three frameworks described above:

Framework	***Account of the federal R&D's institutional structure***	***Materials for analysis***
Neo-Polanyian (Block, Schrank, Whitford)	Reflection of decentralized production in the economy; conflict with anti-statist ideology	Policy history; evidence of popular ideology
Military Exceptionalist	Limited scope and	Policy history within the

(Weiss)	secretive nature of the "National Security State"	National Security State
State Structuralist (Kleinman, Hart)	Decentralized and permeable structure of American government and non-programmatic political parties	Detailed process tracing of legislative history and reform moments
Business-State Nexus (Present study)	Threats to key interests of R&D-intensive industrial firms	Policy history similar to the above but with a focus on activities of business organizations, primarily NAM

Political Economy and American Developmentalism

This study also aims to build on the comparative literature on political economy and industrial policy. If the postwar R&D system can be analyzed as an American variant of the state-driven developmentalism pursued by other industrialized countries, then the methods used to study development experiences in those countries may be useful in the American context. Though the business-state nexus vis-à-vis federal innovation policy has not been previously examined, this type of political economy analysis has been fundamental to the classic cases of industrial policy. While some analyses have focused on factors such as the relationship between the state and civil society, or between the state and labor,[xlix] most political economy-focused work has emphasized the critical relationship between the state and business. For example, in his classic comparative study of business-government relations in industrial upgrading, Peter Evans found that a particular type of symbiotic relationship between states' industrial policy apparatuses and the private sector allowed for the exchange of information that made industrial policy effective.[l] Though she placed greater emphasis on the internal characteristics of the developmental state, Amsden noted in several of her works that the political leverage these states wielded over capital allowed them to pursue "disciplinarian" forms of industrial policy:

> All governments know that subsidies are most effective when they are based on performance standards. Nevertheless state power to *impose* such standards, and bureaucratic capability to implement them, vary from country to country...The state in Korea, Japan, and Taiwan has been more effective than other late-industrializing countries *because it has had the power to discipline big business*.[li]

A closer analogy to the present study is Vivek Chibber's *Locked in Place*, an analysis of why India failed to "install a developmental state" capable of organizing the business class into a national developmental project. In contrast to those who argue that internal characteristics of the Indian state doomed the post-Independence developmental project, Chibber contends that the particular preferences of the Indian capitalist class for a non-disciplinary form of industrial policy, and the failure of Nehru's government to impose a more disciplinary form, resulted in a weak and ineffective developmental state up until liberalization in the 1980s and 90s. While the Indian state possessed the requisite internal structure and capacity, its lack of sufficient leverage over business prevented it from creating the institutional structures necessary to impose effective industrial policy over business:

> ...the Indian state managers' agenda was frustrated by a well-organized offensive launched by domestic capitalists...Indian capitalists in the years immediately after Independence refused to countenance a state with wide-ranging regulatory and interventionist powers, and organized effectively against it. In so doing, they reduced the autonomy and power of political elites to build the institutions they had proposed.[lii]

Chibber's review of the Indian development experience sought to "bring capital back in," a framework that broke with the state-centric approach taken by most analysts of developmental states. The present study makes the same analytic move with respect to federal innovation policy in the US. While previous studies have looked to various factors within the state—pointing to the roles of particular individuals, the self-insulation of military bureaucracies, and the structural characteristics of the state itself—this study looks instead to the relationship between the postwar science state and the organized group of science-heavy firms most impacted by it. Chibber's work also points to the importance of distinctions between institutional varieties of industrial policy and how those types may serve to satisfy or alienate the preferences of business. In the Indian case, for example, the national business class was in favor of the state adopting some industrial policy levers but not others—specifically those that would have imposed some degree of discipline over firm performance in exchange for state subsidies. As this study aims to show, a version of the same phenomenon played out in the postwar American story, with the operative segment of the business class supporting an institutional structure for federal R&D programs that best satisfied its particular concerns.

There are more general reasons why the business-state nexus framework used in the comparative development literature may be particularly well suited to the US. As Michael Mann and other sociologists have argued, business has nearly always been a more dominant power center in American society relative to other sources of power—including the church, the military, labor, and the state itself—when compared to other developed countries, including those "late developers" that pioneered the use industrial planning.[liii] William Domhoff and Michael Webber identify four deep structural causes of American capital's uniquely powerful position.[liv] First, unlike much of Europe, Japan, and other East Asian countries, the US never had a power feudal or quasi-feudal elite that could rival the emerging capitalist class during the rise of industrial production for control over the state. Second, the decentralized structure of the early US government became easily captured by local and regional economic elites. Third, the US military established civilian military traditions, an indirect result of the lack of major military rivals on American borders. And fourth, the US lacked a single established church that could compete with the power of economic elites.

We may add to this list the uniquely weak role of labor in American society, which Mike Davis chalks up to racial and ethnic disunity among workers, violence carried out by capitalists, and a long series of contingent political events that led to a small and relatively non-combative labor movement over the long run.[lv] Taken together, these factors suggest that the impact of the American business class over any policy area with serious economic consequences—the federal R&D system being one of them—would be a natural starting point for analysis of that policy. Moreover, given the relatively outsized role of business in shaping national policy in the US compared to developmental states, the class-based business-state framework may be even better suited to the US than those other states. If this framework can be used to understand the classic developmental states, then it can certainly be used to understand the American "hidden developmental state."

This framework does, however, carry some limitations, particularly when applied to the present subject. The argument developed in this study should not be read to say that industrial firms were the *only* significant influences over federal innovation policy from outside the state. Other sources of influence and institutional power have played leading roles in determining the course of the federal R&D system, and other studies of the history of postwar innovation policy should take these sources into account. These include, firstly, the university system, which served as one of the primary beneficiaries of the federal government's newfound research largesse during WWII. The NSF, NIH, DARPA, and many others have been major boons to university science and engineering programs, and universities have in turn sought to influence federal science policy to suit their own needs. No university in the nation better represents this kind of embeddedness than MIT. From its founding, MIT faculty often worked in partnership with external contacts, including industrial R&D laboratories and occasionally government projects.[lvi] WWII's R&D boom turned MIT into a quasi-permanent R&D contractor, and the Institute established entirely new research centers and departments using federal money. To this day, MIT continues to be a major lobbying force for science policy in Washington and has the political clout to influence legislative priorities.

The emergence of the research university system as a powerful independent influence over innovation policy did not occur, however, until after the basic institutional framework for the postwar R&D system had already been established. While modern university lobbies did not take shape until the 1970s and 80s, major federal innovation programs had already been running for several decades and major institutional choices had been made. Moreover, it is difficult to develop a historical account that cleanly separates "industry" from "universities," particularly during the critical formative years of the 1940s and 50s. Vannevar Bush, the most influential R&D policy voice during and immediately after WWII and the leading architect of the NSF, is a case in point. Bush was both an academic and an industrialist, having founded Raytheon over a decade before entering Washington, and wanted to maintain the emerging system of public-private R&D partnerships with industry that he helped develop during the war.[lvii] Many members of Bush's elite cadre of wartime science advisors were similarly entrepreneurial. This is not to say that Bush and his colleagues acted out of personal gain, but rather that their perspectives and interests were not cleanly separable from those of industry leaders.

This study will also leave out another key source of influence that often plays a dominant role in political economy accounts of development in other countries: labor. The union movement was, of course, critical to the passage of many economic reforms in the 20th Century, and labor commanded a historically strong position in national policy making just as public R&D emerged as a phenomenon in the late 1930s and into the 1940s. For the most part, however, unions were not vocal in the debates over how to structure federal innovation programs, leaving the struggle for a progressive vision for R&D policy up to the remaining New Dealers in a Congress that was then moving back to the right. This was in striking contrast to other forms of federal spending that promised a more immediate impact on jobs and wages, like the federal military budget writ large. For example, recent work on the emergence of "military Keynesianism" during the Korean War suggests that the unions were a key voice in pushing for larger military budgets as a means of confronting economic slow-down.[lviii] The critical distinction may simply have been that while the benefits of military Keynesianism are immediately felt by union workers, federal R&D programs deliver benefits years into the future, if at all. Another possibility is that industrial firms separated unionized production floors from non-unionized corporate laboratories, where they employed higher-skilled workers at already much higher pay.[lix] Future work is needed to tease out the puzzle of labor's silence on R&D policy.

Beyond the role of labor, this study does not for the most part delve into some of the broader distributive questions that are implicated by the R&D system. The primary distributional issue discussed in the chapters to follow is the dichotomous choice over patent ownership, with the government one on side and the private sector on the other. Of course, the actual distributive consequences of R&D policy over the preceding decades have been far more complex and granular. Large firms that have participated in state-led R&D projects have likely benefited at the expense of smaller competitors, and certain geographical regions, primarily the West Coast and the Northeast, have been subsidized through the federal innovation system while others were left deprived of these valuable resources. The choices made in R&D policy have undoubtedly had demographic consequences as well. For most of the history discussed in this study, the primary beneficiaries of innovation subsidies were likely overwhelmingly highly educated white workers, scientists, and engineers. Without major initiatives to dramatically increase the diversity of America's research workforce, the R&D system may have played some role in maintaining the US's demographically retrograde system of social mobility. These granular distributive choices fall outside the scope of this study, but it is important to note them here at the outset.

Overview of the Argument

Why did the federal R&D system in a decentralized, fragmented, and ad hoc structure? An examination of the history of federal innovation policy through the lens of the business-state nexus reveals that the debates over R&D centralization and planning were inextricably bound up with a second key institutional choice: the transfer of intellectual property rights resulting from government-led R&D projects into private hands. R&D-focused industry represented on NAM's research committees were opposed to various proposals for centralized R&D planning, but only insofar as these proposals also threatened the emerging practice of "contractor-take-all," which had become a reliable source of new profits with the rise of modern innovation policy. When these two institutional choices became decoupled, and proposals for R&D planning no longer included reforms to government patent policy, NAM shifted in favor of a more coordinated R&D system. By the time the pro-business policy of patent transfer was finally secure, industrial capital had come to fully support a more planned vision for federal R&D, but it had also lost the political influence it once had over national policy making and could not bring this vision into being. R&D-intensive industrial firms chose patents over planning—they won the battle over government-funded intellectual property rights but helped reinforce the federal R&D system's fragmented structure.

This argument is therefore three-pronged. First, it tracks the policy debates over centralized R&D planning in the US beginning with early treatments by Roosevelt's National Resources Planning Board all the way to Reagan's Presidential Commission on Competitiveness. As I will argue, the debates over R&D planning can only be understood in the context of debates over economic planning in general. Each chapter thus discusses intellectual currents and policy battles over both R&D planning specifically and economic planning more broadly. Second, the argument examines the evolution of debates and various reforms to government patent policy. As with the first prong, these debates cannot be divorced from the broader currents affecting patent law and policy, the most important of which was the antitrust movement and its encounter with the monopolistic patent practices of industrial giants. I suggest that the critique of "contractor-take-all"—the practice of transferring patent rights from government-funded projects to private contractors—lost its potency when the neo-Brandeisian attack on patents had subsided, at which point all that remained was a more narrow "fairness" argument that industry could more easily combat. Third and most importantly, the argument will demonstrate the response on the part of industry to the first two prongs over the course of federal R&D's evolution. I will show that while industrial capital initially opposed a centralized innovation system, it demonstrated a newfound pragmatic stance toward R&D planning once the debate over patent ownership began to shift decisively in its favor.

The argument developed is in effect a synthesis of two perspectives that bear some relation to federal innovation policy. I draw from the literature on the structure of the R&D system from the sociologists, political scientists, historians, and heterodox economists noted above in the review of the three already-existing frameworks. The business-state lens on the subject reveals that what these accounts have critically lacked is a focus on the decisive role of property in the policy history of the R&D system. Giving the patent question its due as a causal factor thus requires importing perspectives from legal scholarship that details the history of intellectual property law and policy. The growing body of work on "innovation beyond intellectual property" is particularly relevant here, as much IP scholarship in this area has focused on direct support for research by the federal government. Additionally, it brings into this study a framework from the law and political economy movement, which seeks to illuminate the power relations and distributive questions implicated in certain legal and institutional choices.[lx] The argument thus pays particular attention to background developments in antitrust and patent law—and, where possible, the nexus of the two—as these developments gave shape to the specific debates over the federal R&D system. Only a combination of these two perspectives can provide a full account of the institutional story at play.

Chapter 1 sets the stage for the rest of the argument by tracing the two reformist tendencies––New Deal central planning and Brandeisian anti-monopolism—that would converge by the sudden increase in publicly funded R&D at the outbreak of the Second World War. Following the rise of industrial R&D as a major feature of modern industrial capitalism, reformers from the planning tradition developed ideas for rationalizing the country's research efforts in accordance with the institutional commitments of New Deal planning, while the trustbusters sought to promote innovation through attacks on the concentration of patents held by industry giants. As this chapter recalls, these two reform traditions prompted strikingly different responses from the nation's industrial business leadership. While NAM often sought pragmatic accomodation with New Deal planning, it reacted to the New Deal's antitrust phase with marked hostility and interpreted the neo-Brandeisian assault on the patent system as an existential threat. In the context of this anti-monopolist attack on patents, the reemergence of the planning idea during WWII set the stage for the debate over how to structure postwar public R&D.

Chapter 2 details the critical period in which the basic institutions of postwar innovation policy were first developed and sheds light on NAM's role in shifting the direction of key policy debates. The battle over how to organize state-backed R&D both during and after the war led to a split over the structure of what became the NSF between Harley Kilgore, a New Dealer who proposed an "Office of Scientific and Technological Mobilization" that embodied the commitments of both New Deal planning and neo-Brandeisianism, and Vannevar Bush, who called for a more decentralized alternative that would allow government contractors to retain patent rights. Kilgore's proposals prompted attacks from NAM and ultimately forced the Association to formulate its own positions on the proper role of the government in promoting R&D. Ultimately, NAM would endorse a model for postwar innovation policy that closely resembled Bush's original vision. I will show, however, that the institutional conflict that most animated NAM's response was not the debate over centralization and planning, but rather over the ownership of government-sponsored patents.

Chapter 3 covers the radical expansion of the postwar science state in the midst of the Cold War and the Space Race. Despite the unprecedented levels of overall R&D funding during this period, the fragmented structure of the R&D system survived. For the most part, NAM welcomed the post-Sputnik R&D explosion, as the Association created a new pro-public R&D Research Committee dominated by high-tech firms that relied heavily on federal research agencies. Part of this moderate turn also included a new attitude toward some calls for a revival of a Kilgore-esque centralized R&D program, though NAM did not outright endorse the idea. On the patent question, however, NAM faced a revival of the second feature of Kilgore's plan, as the dramatic growth of federal research resurrected the push to safeguard government-funded inventions within the public domain. NAM emerged as the dominant lobbying voice in new legislative disputes over government patent policy and helped ensure that these new calls for reform were stymied. The two key institutional choices that had defined the struggle over postwar R&D during the 1940s—whether to create a centralized and planned R&D system, and whether to transfer patent rights to contractors or to retain them in the government—thus became decoupled in reform proposals during this period. With these institutional choices no longer linked as they had been, NAM evinced a clear shift in the direction of support for a more planned innovation policy. There were thus four institutional visions on the table by the early 1960s, each having been identified with a major policy proponent at some point:

	Centralized and planned	***Decentralized and unplanned***
Government ownership of IP	Sen. Harley Kilgore	Sen. Russell Long
Contractor ownership of IP	Sen. Hubert Humphrey	Vannevar Bush

Chapter 4 concludes the argument by examining the incongruous expansion of the public R&D system during the neoliberal era. This period began with NAM's decisive triumph in the decades-long controversy over government patent policy, as the Stevenson-Wydler Technology Act and Bayh-Dole Act ushered in the "technology transfer" consensus that secured NAM's long-held position in favor of "contractor-take-all." With the battle over government patent policy now won, NAM showed a renewed interest in government coordination of industry and in R&D planning in particular. NAM's new Technology Committee looked to Japan's Ministry of International Trade and Industry (MITI) for inspiration and lobbied for new forms of government-business collaboration at the federal level. Eventually, NAM would put forward a version of an industrial policy that would remake the federal R&D system as one of its key components. By the onset of the neoliberal period, however, NAM had lost much of its political influence, a result of deep transformations in the nation's economy that had taken root in the postwar era and came to full fruition by the late 1970s. With NAM sidelined and the Hayekian critique of planning now the conventional wisdom of the day, the Reagan business coalition of finance capital, Sunbelt real estate, and, most significantly for R&D policy, high-tech entrepreneurial capital in Silicon Valley won a mix of tax and regulation cuts along with one-off federal programs to promote specific high-tech subsectors. This new "hidden developmental state," in which the federal government's R&D programs are the unspoken source of the nation's capacity for innovation, would remain intact until the present.

Patents, Planning, and the Future of Public R&D

The role of industrial capital in shaping the R&D system thus unfolded first as a defensive political attack, then as pragmatic adaptation, and then finally as missed opportunity. Viewed through the business-state lens, the structure of postwar innovation policy is more the result of a conflict over property than over planning. In each period addressed in the argument, a major external "shock" prompted forces within the state to consider reforms to the government's engagement with research or actually pass those reforms. These shocks were either real and immediate, as in the case of the Great Depression and WWII, or merely perceived and longer-term in their potential consequences, as with the national panic over Soviet and later Japanese technological dominance. The responses of industrial capital to these proposed reforms were critical in determining which were actually carried out, but only when industrial firms had the political clout to exert such influence. As the table suggests, by the 1970s and 80s, industrial capital had been replaced on the national political stage by other segments of the business class, and this led to a host of reforms to the federal R&D system that might have been different had industrial firms maintained their prior political position. The following table summarizes each period addressed in the argument, laying out each of these three factors:

Period	***External shock***	***Dominant R&D capital formation***	***Reforms***
1930s	Great Depression	Industrial	Consideration of R&D planning; no major reforms
1940s	WWII	Industrial	Creation of the NSF; maintenance of pluralist wartime R&D system
1950s/1960s	Soviet technological/military threat	Industrial, military-industrial	New leading agencies; increased fragmentation
1970s/1980s	Japanese competitive threat	Entrepreneurial, military-industrial	Technology transfer consensus; further decentralization

As I will describe in greater detail in the conclusion, the US has entered what is likely to be another period of debate and potential reform of its innovation system. With a technologically dominant China now an established feature of the global competitive landscape, the 1980s debates over industrial policy have resurfaced, this time in an environment in which hardlined anti-statism appears to be in decline. A renewed interest in public R&D as a means of combating climate change has also emerged in parallel. How these competing claims on the innovation system will play out depends on broader shifts in political movements and events in the years ahead. Having undergone dramatic structural changes since the 1980s, American industrial capital is no longer the power broker of federal R&D politics that it once was. However, the institutional choices that determined NAM's policy positions in previous eras—R&D planning, government patent policy, and the link between the two—will likely define these new debates over innovation policy.

As the question of how to organize and coordinate federal R&D returns to prominence, the debate over government patent policy is likely to follow suit. Efforts to revamp public R&D into a form of neo-industrial policy will require greater resources and political support than that commanded by the current system; the American developmental state can no longer remain hidden. This potential shift cannot avoid the question of who owns the fruits of federal research, and already, various proposals have circulated in Washington that call for patent policy reform. These proposals find intellectual backing from the recent revival of the neo-Brandeisian critique of intellectual property, and from the growing public awareness of the US' peculiar "entrepreneurial state" and its effect on the American economy. If these proposals are taken seriously, however, it may alienate the very private firms upon which the federal innovation system depends to do critical R&D work. This is, I suggest, a contradiction at the heart of the federal innovation system—indeed, of any economic planning effort led by the state in partnership with the private sector. Whether and how this contradiction gets resolved may determine the course of American innovation policy, and with it, our shared technological future.

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[i] Watts, Steven. *The People's Tycoon: Henry Ford and the American Century*. Vintage Books, 2006.
[ii] Locke, Taylor. "Elon Musk on His Success." *CNBC*, CNBC, 3 June 2020, www.cnbc.com/2020/05/26/elon-musk-on-his-success-america-is-the-land-of-opportunity.html
[iii] Lind, Michael. *Land of Promise: an Economic History of the United States*. Harper, 2013.
[iv] This difficulty applies to any form of sectoral targeting led by the government. Ha-Joon Chang has argued that all forms of industrial policy tend to elude precise quantitative impact assessments, a result of long time delays between interventions and outcomes and of spillover effects that ripple across the economy and are thus difficult to measure. Chang, Ha-Joon, Industrial Policy: Can We Go Beyond an Unproductive Confrontation? World Bank, 2010.

[v] Block, Fred L., and Matthew R. Keller. *State of Innovation: the U.S. Government's Role in Technology Development*. Routledge, 2011.
[vi] Singer, Peter L., *Federally Supported Inventions*: 22 Examples of Major Technology Advances that Stem from Federal Research Support. The Information Technology and Innovation Foundation, 2014. http://www2.itif.org/2014-federally-supported-innovations.pdf
[vii] *Id.* at 18-19.
[viii] Houseman, Susan N. 2018. "Understanding the Decline of U.S. Manufacturing Employment." Upjohn Institute Working Paper 18-287. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/wp18-287.
[ix] Singer, 2014.
[x] Mazzucato, Mariana. *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*. Anthem Press, 2015.
[xi] Block, Fred. Swimming Against the Current: The Rise of a Hidden Developmental State in the United States. *Politics & Society*. 2008; 36(2): 169-206.
[xii] Mazzucato at 169.
[xiii] Chalmers Johnson, for example, provided an account of the "Japanese Miracle" after WWII that emphasized the role of a particular economic policy agency within the Japanese state, the Ministry of International Trade and Industry (MITI). This will be discussed in Chapter 4.
[xiv] Amsden, Alice H. *Asia's next Giant: South Korea and Late Industrialization*. Oxford University Press, 1992.
[xv] Wade, Robert. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. Princeton University Press, 2004.
[xvi] E.g., Mazzucato 2015, and Chang, Ha-Joon. *The Political Economy of Industrial Policy*. Macmillan, 1994.
[xvii] Block, 2008.
[xviii] Tucker, Todd. "Industrial Policy and Planning: What It Is and How to Do It Better," July 30, 2019, Roosevelt Institute, at 6.
[xix] Block and Keller (2011) at 20.
[xx] *Id.* at 15.
[xxi] Schrank, Andrew and Joshua Whitford, Industrial Policy in the United States: a Neo-Polanyian Interpretation, *Politics and Society*, 2009.
[xxii] Block (2008); *Id.*
[xxiii] Wade, Robert H. (2017) The American Paradox: Ideology of Free Markets and the Hidden Practice of Directional Thrust. Cambridge Journal of Economics. ISSN 0309-166X.
[xxiv] Lind at 463.
[xxv] Gruber, Jonathan, and Simon Johnson. *Jump-Starting America: How Breakthrough Science Can Revive Economic Growth and the American Dream*. PublicAffairs, 2019, at 180-185.
[xxvi] Rubio, Marco, US Senate Small Business Committee, "Made in China 25 and the Future of American Industry." https://www.rubio.senate.gov/public/_cache/files/d1c6db46-1a68-481a-b96e-356c8100f1b7/3EDECA923DB439A8E884C6229A4C6003.02.12.19-final-sbc-project-mic2025-report.pdf
[xxvii] De Rugy, Veronique, "Why Are Republicans Embracing Economic State Planning?" *NYTimes*. Mar 5, 2019. https://www.nytimes.com/2019/03/05/opinion/china-marco-rubio-republicans-industrial-policy-.html

[xxviii] Meyer, Robinson, "A Centuries-Old Idea Could Revolutionize Climate Policy" The Atlantic. Feb 19, 2019. https://www.theatlantic.com/science/archive/2019/02/green-new-deal-economic-principles/582943/
[xxix] Block 2008; Schrank and Whitford 2009; Brandt, Philipp, Andrew Schrank, and Josh Whitford, Brokerage and Boots on the Ground: Complements or Substitutes in the Manufacturing Extension Partnerships?, *Economic Development Quarterly*, 2018.
[xxx] Block 2008.
[xxxi] E.g. Slobodian, Quinn. *Globalists: the End of Empire and the Birth of Neoliberalism*. Harvard University Press, 2018.
[xxxii] Weiss, Linda. *America Inc.?: Innovation and Enterprise in the National Security State*. Cornell University Press, 2014.
[xxxiii] *Id.*
[xxxiv] Kleinman, Daniel Lee. *Politics on the Endless Frontier: Postwar Research Policy in the United States*. Duke Univ. Press, 1995; Hart, David M. *Forged Consensus: Science, Technology, and Economic Policy in the United States, 1921-1953*. Princeton University Press, 1998; Graham, Otis L. *Losing Time: Industrial Policy Debate*. Harvard U. P., 1994.
[xxxv] Kleinman at 22.
[xxxvi] *Id.* at 217.
[xxxvii] E.g., Finegold, Kenneth, and Theda Skocpol. *State and Party in America's New Deal*. University of Wisconsin Press, 1995.
[xxxviii] This reflects a commitment to a "pluralist" lens on American policy making and society, a dominant framework in social analysis.
[xxxix] E.g. Josephson, Matthew. *The Robber Barons: the Great American Barons, 1861-1901*. Harcourt, Brace, 1934.
[xl] E.g. Schlesinger, Arthur Meier., and Franklin Delano Roosevelt. *The Politics of Upheaval*. 1960.
[xli] John, Richard R, and Phillips-Fein, Kim, *Capital Gains: Business and Politics in Twentieth-Century America*, 2016.
[xlii] Phillips-Fein, Kim. *Invisible Hands: the Businessmen's Crusade against the New Deal*. W. W. Norton, 2010.
[xliii] Whitham, Charlie. *Post-War Business Planners in the United States, 1939-48: The Rise of the Corporate Moderates*. Bloomsbury Publishing, 2016.
[xliv] Mizruchi, Mark S. *The Fracturing of the American Corporate Elite*. Harvard University Press, 2013.
[xlv] Delton, Jennifer. *The Industrialists: How the National Association of Manufacturers Shaped American Capitalism*. Princeton University Press, 2020.
[xlvi] *Id.*
[xlvii] Noble, David F. *America by Design: Science, Technology, and the Rise of Corporate Capitalism*. Oxford Univ. Press, 1977.
[xlviii] Chandler, Alfred D., "Industrial Revolutions and Institutional Arrangements," *Bulletin of the American Academy of Arts and Sciences*, 1980, Vol. 33, No. 8.
[xlix] E.g. Haggard, Stephan, and Robert R. Kaufman. *Development, Democracy, and Welfare States: Latin America, East Asia, and Eastern Europe*. Princeton University Press, 2008.
[l] Evans, Peter B. *Embedded Autonomy States and Industrial Transformation*. Princeton University Press, 1995.

[li] Quoted in Chibber, Vivek. *Locked in Place State-Building and Late Industrialization in India*. Princeton University Press, 2003, at 7.
[lii] *Id.* at 9.
[liii] E.g., Mann, Michael. *The Sources of Social Power*. Cambridge University Press, 2013.
[liv] Domhoff, G. William, and Michael J. Webber. *Class and Power in the New Deal Corporate Moderates, Southern Democrats, and the Liberal-Labor Coalition*. Stanford University Press, 2011.
[lv] Davis, Mike. *Prisoners of the American Dream: Politics and Economy in the History of the US Working Class*. Verso Books, 2018.
[lvi] As discussed in Noble (1977). Kaiser, David. *Becoming MIT: Moments of Decision*. MIT Press, 2012.
[lvii] Zachary, G. Pascal. *Endless Frontier: Vannevar Bush, Engineer of the American Century*. Free Press, 2018.
[lviii] Barker, Tim. *How to Pay for the War: The Political Economy of Military Keynesianism in the United*
States, 1945-1979 (Dissertation in progress).
[lix] As discussed in: Reich, Leonard S., *The Making of American Industrial Research: Science and Business at GE and Bell: 1876-1926*. Cambridge University Press, 1993.
[lx] Britton-Purdy, Jedediah S. and Grewal, David Singh and Kapczynski, Amy and Rahman, K. Sabeel, Building a Law-and-Political-Economy Framework: Beyond the Twentieth-Century Synthesis (March 2, 2020). Yale Law Journal, Forthcoming, Columbia Public Law Research Paper No. 14-657. *See also* Rahman, K. Sabeel, Domination, Democracy, and Constitutional Political Economy in the New Gilded Age: Towards a Fourth Wave of Legal Realism?, 94 Texas Law Review 1329 (2016).

Chapter 1:

Putting Innovation to Work:
Research Monopoly, New Deal Reformism, and the Emergence of Public R&D

Before World War II remade American political economy and transformed the federal government into the nation's leading promoter of R&D, a number of competing reform traditions had already addressed the potential role the government could play in driving innovation for public benefit. Two of these reformist movements—New Deal central planning and Brandeisian anti-monopolism—would eventually converge by the outbreak of the war and define the debate over postwar public R&D. Both of these traditions were rooted in reformist movements stretching back to the early Progressive Era, and both came to prominence at different moments in the New Deal and the Roosevelt Administration's efforts to combat the Great Depression. While the first phase of the New Deal ushered in a number of ambitious experiments in planning, including an attempt at national industrial coordination led by the federal government, the New Deal's second phase largely abandoned the planning impulse and instead initiated an assault on concentrated economic power. This produced two profoundly different approaches to research policy: reformers from the central planning tradition developed ideas for rationalizing the country's research efforts in keeping with the institutional commitments of New Deal planning, while the trustbusters sought to promote research through attacks on the concentration of patents held by industry giants.

As this chapter will demonstrate, these two reform traditions also prompted strikingly different responses from NAM and the rest of the nation's business leadership. Industry sought cooperation with the New Deal central planners, often actively participating in the design and implementation of national planning experiments across sectors. Though always somewhat suspicious of the planners, particularly the more radical members of Roosevelt's administration like Rexford Tugwell, business leadership often agreed with the approach taken during the "First New Deal" toward an increasingly cooperative partnership between big business and the state. In contrast, business leadership reacted to the New Deal's antitrust phase with marked hostility, and NAM and other industrial leaders perceived the emerging assault on the patent system as a fundamental threat. In the midst of the anti-monopolist attack on patents, the reemergence of the planning idea during WWII set the stage for the debate over how to structure postwar public R&D. As the next chapter will argue, the unusual convergence of both of these reform traditions during this debate prompted NAM to turn against proposals for R&D planning.

I begin this chapter with an overview of New Deal planning that includes the movement's intellectual foundations, key figures, and major policy experiments during the initial years of the Roosevelt Administration. I then recount the reaction of key elements of the national business class, including NAM, toward these intellectual developments and policy experiments. Next, I review the rise of large-scale industrial R&D and the shift of both the planners and NAM toward R&D as a new area of political advocacy and policy making. The chapter then pivots toward the second reformist tradition of this period, anti-monopolism, and provides a similar overview of its origins and basic commitments. I describe how neo-Brandeisians also encountered industrial R&D during the same period, and launched an attack on patent monopolies and on the patent system as a whole. I then detail NAM's reaction to the Brandeisian revival in general and to the patent debates in particular. The chapter concludes at the outbreak of WWII and the sudden emergence of public R&D on a massive scale.

"Concentrate and Control": The Basic Commitments of New Deal Planning

The first of the two major reform movements that converged in the wartime debate over public R&D was the New Deal planning tradition. The intellectual origins of this movement trace back to the late 19th Century, when reformers first began to devise systemic responses to the problems of industrial society in the US. The rise of modern industry and "big business" split reformist movements into two: on one side, a group of intellectuals and policy makers assailed "bigness" and sought to curtail corporate power through the antitrust mechanism, while on the other side, a rival reformist movement embraced a future of increasingly productive corporate giants that would be integrated into a cooperative system of partnership with the state. While the former movement would evolve into anti-monopoly progressivism that spawned the Sherman and Clayton antitrust laws, the latter would reach its maturity in the early years of the New Deal, when reformists with deep commitments to economic planning influenced the direction of national policy.

The institutional commitments of New Deal planning trace back to the "New Nationalism" of Teddy Roosevelt, who endorsed a revival of a much older Hamiltonian conception of American national developmentalism. The intellectual thrust of Roosevelt's New Nationalism was well captured by a select group of Progressive Era businessmen who advocated for a new structure for the federal government that could institute a "more highly socialized democracy" through national planning. Prominent banker George Perkins, for example, asserted that market competition by the early 20th Century would deliver nothing but "exploitation, evil working conditions, and unemployment." Instead of promoting increased competition through the antitrust acts, the federal government should pursue a new regime of "cooperation" between industry and government that would function as "socialism of the highest, best and most ideal sort."[i] Roosevelt's New Nationalism offered a new view of the American state that embraced the newly emerged corporate behemoths and saw in them a radical potential to overcome the social problems of industrialization.

Progressive-era intellectuals helped develop this movement's conceptual grounding. Charles Van Hise's *Concentration and Control: A Solution of the Trust Problem in the United States* (1912), said to be a favorite of Teddy Roosevelt, advocated for a large and capable national government with the legal power to direct the activities of major corporations in the public interest. "If we allow concentration and co-operation," Van Hise wrote, "there must be control in order to protect the people," and this level of control could only be achieved through a newly reconstituted state.[ii] John Dewey, the leading American political philosopher of the Progressive and New Deal eras, justified the need for national planning on more basic philosophical grounds. In *Individualism Old and New*, written on the eve of the Great Depression, Dewey marshalled a critique of the "19th Century individualism" embodied by Herbert Hoover and advocated instead for a new "democratic collectivism" built on American republican principles.[iii] Inspired by the country's abandonment of *laissez faire* and embrace of national economic mobilization during WWI, Dewey imagined a democratically accountable "National Economic Council" made up of government, business, and labor representatives, an institutional vision that would inspire many of the New Deal planners in the following decade.

The emerging American central planning tradition thus represented a decisive break from the framework of 19th Century liberalism, which prescribed a minimal role for the state in preserving basic institutions of private property and contract rights. The most radical members of this emerging tradition had much in common with left-wing planners in Europe, including a belief in the supremacy of rational planning over market anarchy and in some of the normative justifications for planning as a form of democratic exercise. However, unlike their counterparts in Europe, the New Deal planners did not draw from Marxian economics or any other school of Marxist thought. Rather, their primary inspiration was the new school of institutionalist economics pioneered by the American economists Simon Patten and Thorstein Veblen. Both Patten and Veblen believed the technological capacities that had emerged during the industrial age could deliver an "age of abundance" that would liberate mankind, but only if a society's industrial technology could be harnessed by a rational planning mechanism.

Veblen launched an attack on the orthodox economics of the early 20th Century, asserting that many of its basic assumptions and abstract models had no link to economic activity in the actually-existing economy. In his *Theory of Business Enterprise*, Veblen first posited the central distinction between "industry," understood as the collective technological capacities of an advanced society, and "business," framed as profit-oriented activity in the market. This distinction between industry and business—alternatively, between "technology" and "capitalism"—had come to define American economic life and would serve as the key site of political struggle in the decades to come.[iv] For Veblen, the price system and market competition were the mechanisms through which technology's potential to produce a world of abundance were thwarted; intelligent planning that overcame the market could rescue that potential and direct it toward the public good.[v] In his most radical moment, Veblen published *The Engineers and the Price System* in 1921, which laid out an entire design of a planned economy that would be organized "as a systemic whole." Though this work was marginal during the era of "business rule" in the 1920s, it had a lasting impact on the rising generation of institutionalists who would lead New Deal planning experiments in the early Roosevelt years.

Several of these planners are worth considering individually and in some detail. Though they may have differed on some points of emphasis, they all shared a commitment to the basic strategy of "concentration and control," in which "bigness" was to be embraced and directed by a planning mechanism. For example, Adolf Berle and Gardiner Means, who served in different capacities as economic advisors to the Roosevelt Administration, thought the rise of large and monopolistic corporations was inevitable, and that to try to solve social and economic problems through an antitrust strategy would be to "roll back the clock." What Berle and Means called for instead was a new "administered market" in which large corporations would somehow be directed into a "unified, controlled, sensible operation" by the technocratic capacities of the state.[vi] The pair did not, however, articulate a vision for public policy anywhere near as radical as Veblen's technocratic edifice, suggesting instead government-led demand, the restructuring of the stock market and corporate charters, and the reform of the antitrust system to allow for further consolidation and management.[vii]

Rexford Tugwell, perhaps the most influential New Deal planner and the key force behind many of the major planning experiments of the "First New Deal," shared Berle and Means' embrace of consolidation but went much further in his vision for alternative institutional arrangements. Tugwell believed that long term weaknesses of the economy resulted from the inability of firms—particularly the technologically advanced Taylorist firms that had come to dominate the economy—to coordinate investments in such a way as to avoid overproduction and to best utilize revolutionary new technologies.[viii] He accepted that modern technology and scientific production methods would push firms to increase their scale in order to translate those technological advances into efficiency gains. To try to reverse corporate concentration and the achievement of new levels of scaled production—through, for example, strict antitrust enforcement—would pit the government "against inevitable, unconquerable industrial forces."[ix] For Tugwell, it was better to work *with* the inevitable—to develop new forms of state-industry cooperation that could better exploit the radical potential of new technologies.

Tugwell believed the 1929 crash had finally exposed the fatal flaw of the "ancient paradox of business"—that firms in fierce competition with one another were expected to generate economic stability over the long run. In *The Principle of Planning and the Institution of Laissez Faire*, a tract that sought to capture the emerging consensus among Tugwell's generation of institutionalists, Tugwell cast national economic planning in stark contrast to the existing system built on liberal market principles.[x] The planning idea represented "the opposite of conflict," a system of production "aligned to coordination, to rationality, to publicly defined and expertly approached aims" rather than "the guidance of a hidden hand."[xi] Drawing directly from Veblen, Tugwell distinguished "industry," its connotation linked to productivity and technological advancement, from "business," understood as profit-oriented behavior with all of its associated waste and inefficiency. In a turn of phrase that would haunt his career with controversy, Tugwell called for the "abolition of business"—meant only as the end of business operating under a *laissez faire* system. Like other institutionalists at the time, Tugwell was intrigued by the early Soviet planning experiments and believed democratic versions of these experiments might be in America's near future:

> There is no denying that the contemporary situation in the United States has explosive possibilities. The future is becoming visible in Russia; the present is bitterly in contrast; politicians, theorists, and vested interests seem to conspire ideally for the provocation to violence of a long-patient people...Perhaps our statesmen will give way or be more or less gently removed from duty; perhaps our constitutions and statutes will be revised; perhaps our vested interests will submit to control without too violent resistance...Yet the new kind of economic machinery we have in prospect cannot function in our present economy. The contemporary situation is one in which all the choices are hard; yet one of them has to be made.[xii]

In *The Industrial Discipline and the Governmental Arts*, written only a few months before joining Roosevelt's Brain Trust in 1932, Tugwell sought to translate these political commitments into policy proposals.[xiii] To avoid repeating the crash of 1929 and its disastrous fallout, Tugwell put forward a model of national industrial planning aimed to ensure long-term and stable economic growth in the American economy. Tugwell's vision was a federated national system of industry-wide agencies with which businesses would cooperate voluntarily. These industry-specific agencies would create planning boards, which would develop plans for production, prices, market structure, and labor regulations. These planning agencies would collaborate with each other to encourage inter-industry complementarities. Sitting atop this system of planning agencies would be a centralized "United States Industrial Integration Board," which would be composed of representatives from the various industry-specific groups, and would be given the mandate to coordinate the efforts of sub-agencies in accordance with a national plan.[xiv]

While the central board would not have direct control over the production decisions made by individual firms, it would seek to adjust the production quotas of entire industries to better serve national planning goals. It would have some degree of control over the allocation of capital to specific industries through the management of an "Industrial Reserve Fund" paid for through corporate taxes. The board would also, critically, have control over prices. With these two key levers of control in the hands of the central board, individual firms would be unable to undercut the plans devised by the planning apparatus and would have major incentives to fit their operations in accordance with the plan. To maintain the central board's flexibility while avoiding industry capture, Tugwell wanted the state to maintain ultimate authority on the central board:

> [The central board] ought not to be hampered in its work by too close definition of procedures and standards. It remains true, however, that in such a scheme, in two areas at least, there would need to be a public advocate: the allocation of capital and the regulation of prices. How far these two vital controlling functions could be left to the management of the associations themselves, it is so difficult to foresee that no suggestion seems to be offered. It is clear, however, that public representatives

> would need to have a part in shaping such policies as these. When necessary, they ought to have the final word.[xv]

The proposed structure of this federal system for "industrial integration" thus sheds light on Tugwell's basic institutional commitments, which were emblematic of the New Deal planning tradition more broadly. It was critical for Tugwell that this form of government intervention prioritize the supply side of economic exchange. The goal was to increase the government's control over *production*—primarily through the management of state-directed funds and price controls—in order to integrate the atomized activities of large-scale enterprises into a coherent whole. While Tugwell valued a certain degree of delegation of power and decision-making to lower authorities––in this case, the industry-specific planning agencies—he believed that planning at the national scale would require centralization and the appointment of key levers of control to a central agency. While this central agency should answer to both industry and the government, the latter should maintain ultimate authority. Tugwell's planning apparatus sought to replace a decentralized system of market anarchy with centralized and rationalized public management.

Tugwell's approach to planning can also be understood by which institutional commitments it tended to reject. Though Tugwell and many prominent planners of the time encouraged government spending as part of a broader recovery plan, they did not adopt the Keynesian framework of demand-side intervention that would become the dominant reformist paradigm of the later New Deal. In the early depression years, Keynes himself had not yet risen to prominence in the US, but there were prescient mainstream voices already developing a demand-side theory of depression and potential recovery. For example, in their popular late-20s tracts, including *Business Without a Buyer* and *The Road to Plenty*, William Foster and Waddill Catchings identified the "Dilemma of Thrift" in the American economy that increased industrial output faster than the capacity of consumers to purchase that output.[xvi] Private enterprise alone could not be relied on to right this imbalance; instead, the government would have to commit to counter-cyclical management by "putting more money into consumers' hands when business is falling off, and less money when inflation is under way."[xvii] While this analysis appealed to some members of the early Roosevelt Administration, including then-Secretary of Agriculture Henry Wallace, the planners were for the most part uninterested. Demand-side intervention was seen as fundamentally conservative: Foster and Catchings themselves celebrated the fact that Keynesian management "leaves individual initiative, responsibility, and rewards, throughout the whole domain of commerce and finance, exactly where they are today." Tugwell and the New Deal planners wanted instead to restructure the economy and to shift control over what and when to produce into the hands of public authority.

Public management and planning, however, did not necessarily mean public ownership. The New Deal planning tradition often rejected a dominant Marxist institutional proposal of that era: government ownership of the means of production. The planners did not particularly value public ownership as a goal in itself, but rather as a potential tool to be used in achieving the more fundamental goal of a coordinated economy. On the question of state ownership, Tugwell claimed to have "no feeling about it one way or another." While some New Deal interventions would benefit from full public ownership—for example, in the development and operation of energy resources—Tugwell felt that others "shall equally certainly have to rely on individual initiative."[xviii] The question of ownership was secondary; the actual goal was "the achieving of publicly oriented direction whether of publicly or privately owned or operated agencies."[xix] And while Adolf Berle privately expressed his ambition of becoming "the American Karl Marx—a social prophet," his proposed revolution would be an institutional shift toward coordination and public control and not a radical reshuffling of property rights.[xx] Berle's alternative was a "state capitalism" of privately owned assets subjected to a planning power.

By the time of Roosevelt's election in 1932, this brand of economic planning had fully entered mainstream policy circles and popular debates. Earlier that year, George Soule, then-editor of the New Republic, published *A Planned Society*, in which he advocated for the creation of a National Planning Board that would manage the major production decisions in the economy. Soule believed the establishment of such a planning capacity would mark a "major step away from capitalism."[xxi] Likewise Stuart Chase, perhaps the most widely-read reformist liberal of the era and the man responsible for the popularization of "the New Deal" as a coinage, criticized the emerging proto-Keynesianism of Foster and Catchings as "only patches on a boiler which is destined ultimately to explode." Chase called instead for a new system of "planned production" led by a federal "Peace Industries Board" modeled after the government's brief experiment with central planning during WWI.[xxii]

The popular appetite for "planning" as the path out of depression had grown to such an extent that ideologically flexible politicians, including Roosevelt himself, began to endorse the idea. On the campaign trail in 1932 Roosevelt called for "imaginative and purposeful planning" at the national level as a means of escaping depression. "Economic planning, not for this period alone but for our needs for a long time to come" would be a major theme of the campaign, spurred on by the Brain Trust that included Tugwell, Berle and the planning enthusiast Raymond Moley. Even before his run for the presidency, Roosevelt had evidenced sympathy toward the concept and, as Governor of New York, launched state-level programs in land and natural resource planning that would later become the model for the national-scale Civilian Conservation Corps.[xxiii] At a

Governors' Conference in 1931, Roosevelt suggested these pilot programs could be expanded at the national level:

> Real planning is needed for the complex future. It is time we experimented...I believe that the coming winter is going to bring forth a great many suggestions for experimenting with our economic system...Please do not dismiss these ideas with the word radical. Remember the radical of yesterday is almost always the reactionary of today.[xxiv]

However, despite Tugwell's efforts, planning never emerged as the central element of the 1932 platform. Roosevelt drew instead from a number of policy traditions during his campaign, including some that were deeply at odds with planning, preferring to leave open multiple pathways to reform once he entered the White House. Roosevelt also recognized that planning programs were unlikely to carry the political appeal and potential for mobilization that other forms of relief had demonstrated: in one meeting with Tugwell focused on a proposed speech about national planning, Roosevelt asserted "That kind of thing would have to grow rather than be campaigned for."[xxv]

Actually-existing New Deal Planning

Roosevelt's landslide victory ushered in a period of extraordinary federal policy experimentation. Despite Roosevelt's ideological flexibility and openness to many reform traditions—or perhaps because of it—planning ideas flourished in the early phase of the new administration. For the first time, planners who advocated for a permanent departure from liberal market principles and a restructuring of the relationship between the state and industry found themselves in the halls of national power. What resulted in the first two years of the Roosevelt era was a brief period in which national planning experiments dominated the federal policy agenda. Looking back on this period, Arthur Schlesinger Jr. captured its major themes as follows:

> The tenets of the First New Deal were that the technological revolution had rendered bigness inevitable; that competition could no longer be relied on to protect social interests; that large units were an opportunity to be seized rather than a danger to be fought; and that the formula for stability in the new society must be combination and cooperation under enlarged federal authority. This meant the creation of new institutions, public and private, to do what competition had once done (or was supposed to have done) in the way of balancing the economy – institutions which might well alter the existing pattern of individual economic decision, especially on investment, production, and price.[xxvi]

In practice, the First New Deal progressed as a series of discrete programs, each of them oriented toward a separate domain of the economy, and each distinct in its institutional structure while still advancing the basic commitments identified by Schlesinger. The first of these programs was the Agricultural Adjustment Act (AAA), an effort to stabilize the agricultural sector by controlling farm production output and prices. By Roosevelt's inauguration, the American agricultural sector was in full crisis, with collapsed farm product prices and spiked rural unemployment leading to widespread hunger and even, in some extreme cases, to mass rural violence. Drafted by the new Secretary of Agriculture Henry Wallace and his team, and influenced heavily by Tugwell and the planning-oriented members of the braintrust, the AAA established an unprecedented set of federal policy levers to intervene in the farming sector. These included price controls through government loans or direct government purchase; land leasing to withdraw farmland from production; and the power to enforce national quotas and standards through federal licensing. The AAA was quickly regarded as a radical institutional break; Wallace himself described the policy innovations in the Act "as new in the field of social relations as the first gasoline engine was new in the field of mechanics."[xxvii] Wallace's advisor Mordecai Ezekiel agreed, pronouncing it "the greatest single experiment in economic planning under capitalist conditions ever attempted by a democracy in times of peace."[xxviii]

The institutional structure set up by the AAA reflected many of the core commitments of the New Deal planning tradition. The Act established a series of key supply-side policy levers geared toward control and stabilization of production, and it entrusted these powers in a new central agency, the Agricultural Adjustment Administration, situated within Wallace's Department of Agriculture. Even more strikingly, the Act operationalized some of the more radical features of Tugwell and others' institutional vision for democratic planning. Local information on yields and prices were communicated up the agency hierarchy through "county production-control committees." Identified by Tugwell as the "lifeblood" of the AAA and celebrated by Wallace as an experiment in "economic democracy," these committees were composed of officers directly elected by farmers, and worked to devise their own strategies for conforming local practices to regional and national plans.[xxix] By the time the Act had been fully implemented, over three million farmers were participants—either directly or through elected local representatives—in nearly four thousand local planning committees.

The AAA was largely seen as effective in helping to stabilize the agricultural sector and initiate rural economic recovery. Perhaps more importantly, the Act was a political victory: support for the AAA among farmers was so high that braintruster Raymond Moley could confidently describe it years later as "the most successful and generally popular feature of the New Deal."[xxx] But a more difficult test for the New Deal planners would emerge when the Roosevelt Administration shifted its focus away from agricultural recovery and toward a new and more ambitious goal: control and coordination of the manufacturing sector. With the perceived achievements of production stabilization in farming, national industrial planning quickly emerged in the spring of Roosevelt's first year as the next target of policy experimentation. Support for industrial planning within the Administration had grown beyond the radical members of the braintrust and now included many of Roosevelt's key executive appointees. Reformist legislators, including Senators Robert Wagner and Robert La Follette, were now voicing their support for national control over industry, as were influential and decidedly non-radical national figures such as Bernard Baruch, former head of the WWI-era War Industries Board.[xxxi] Riding this wave of enthusiasm, Roosevelt delivered in his second "fireside chat" a defense of planning and industry-state partnership as the new means to achieving economic stability:

> Government ought to have the right and will have the right, after surveying and planning for an industry to prevent, with the assistance of the overwhelming majority of that industry, unfair practice and to enforce this agreement by the authority of government...The same principle applies to farm products and to transportation and every other field of organized private industry. We are working toward a definite goal, which is to prevent the return of conditions which came very close to destroying what we call modern civilization.[xxxii]

The Administration acted promptly, producing drafts of an industrial planning bill that each differed in their structure and institutional orientation. These competing drafters, including Tugwell, Secretary of Labor Frances Perkins, and several other Roosevelt advisors, ultimately compromised on several of their key positions and sent the finalized bill to Congress, which passed one month later. The National Industrial Recovery Act (NIRA), hailed by Roosevelt as "the most important and far-reaching legislation ever enacted by the American Congress," sought to organize manufacturers into sub-sector-specific trade associations that could coordinate their activities based on agreed-upon production plans and on new codes of fair competition and standards. NIRA established a federal licensing power, an unprecedented new lever of control that the federal government could now use to compel manufacturers to participate in its plan. The Act also created a national protocol for unionization and collective bargaining, which would ultimately lead to the passage of Wagner's National Labor Relations Act (NLRA) two years later. Finally, NIRA established a new Public Works Administration, which would become a long-standing and hugely popular element of the recovery effort. As with the AAA, the industrial planning effort delegated most of the key functions of the NIRA to a new centralized body, the National Recovery Administration (NRA).[xxxiii]

NIRA's implementation struggled from the start. The major difficulty was the absence of key enforcement actions, chiefly the capacity to control prices, which had been a cornerstone of the AAA, and the unwillingness of the NRA to invoke its federal licensing powers to coerce firms into participation. The NRA had to rely instead on the voluntary participation of firms and their newly formed industry groups, which led to substantial inefficiencies and delays. The NRA's first head Hugh Johnson, a prominent proponent of planning within the Administration, refused to push for increased enforcement powers for his agency and sought instead to promote cooperation through a consumer-facing marketing campaign. Participation in NIRA industry groups and adherence to their plans would earn firms the "Blue Eagle," a stamp of government approval aimed at improving the firms' public reputation. NIRA was thus less a pure experiment in government planning than the AAA had been; Johnson himself distinguished the two as such: "AAA thinks that government should run business. NRA thinks that business should run itself under government supervision."[xxxiv] The NRA's inability to directly influence prices and production quotas, and its reliance on industry groups to set their own, failed to solve the stabilization problems to which the Act's architects were responding. Some of NIRA's key components, primarily its labor and public works reforms, would become long-standing features of the recovery. By the time the Supreme Court declared the NIRA unconstitutional in 1935, however, the Act was already widely perceived as being ineffective.

New Deal Planning in Retreat

The NIRA's failures dealt a major blow to the New Deal planning tradition, both by damaging public opinion of the national planning concept and by reducing the influence of the planners in the Roosevelt Administration. The planners suffered a further though less dramatic defeat in the formation and early implementation of the Tennessee Valley Authority (TVA), the New Deal's major experiment in regional planning. The TVA was a large-scale development program focused on electrification, dam-building, and recultivation of one of the poorest and most underdeveloped American regions.[xxxv] Some of TVA's early advocates and leaders framed what they were doing in a broader perspective: Arthur Morgan, one of the TVA's first board members, understood the project to be an experiment in comprehensive economic planning concerned with "the improvement of that total well-being, in physical, social, and economic condition."[xxxvi] Tugwell likewise interpreted the TVA as the regional-development counterpart to the AAA and NIRA, even going as far to describe the TVA as carrying "more significance for the future than any other single attempt of the administration to make life better for all of us."[xxxvii]

Morgan and Tugwell's ambitions for the TVA were largely thwarted. Morgan quickly found himself outmaneuvered on the TVA's three-member board by David Lilienthal and Harcourt Morgan, both advocates of the TVA's narrower development goals and sharp critics of Tugwell's style of central planning. Lilienthal was particularly fearful of "the smooth-talking centralizers" who sought to impose plans on unwilling participants, and was instead an advocate of a smaller-scale, neo-Brandesian vision for the TVA that rejected bigness and aimed to preserve consumer choice. Arthur Morgan's original vision of a powerful regional planning agency that could launch a concerted attack on poverty and aim to restructure social life in the Valley lost out to his rivals' preference for a more narrowly focused TVA that would enlist the private sector on a voluntary basis. The TVA would survive and eventually become recognized as one of the New Deal's signature achievements, but only in this slightly emasculated form rather than as a bold experiment in comprehensive planning. The more restricted general role for the TVA, along with the more widely recognized shortcomings of the NIRA, halted the momentum of New Deal planning significantly. Beyond these policy issues, the broader context had changed: the American economy was still stagnant but no longer in freefall, and the sense of emergency that ushered in these planning experiments had waned. If these planning efforts had played a major role in stabilization, as some contemporary observers believed, they paradoxically undermined their own legitimacy.[xxxviii]

Planning thus retreated from the top priorities of the Administration, replaced ultimately by a new synthesis of antitrust progressivism and Keynesianism developed during the "Second New Deal" following Roosevelt's reelection. Between the First New Deal and the War, however, the planning tradition clung to life through an institution originally created by the NIRA and housed within the Public Works Administration: the National Resources Planning Board (NRPB).[xxxix] The NRPB's role was advisory; it conducted research and issued reports on specific components of the American economy that could be further rationalized through government planning in some form. Despite the broader shift away from the planning tradition, Roosevelt himself was personally invested in the continuation of the NRPB, citing the need for some "permanent long-range planning commission" that could issue recommendations for 25- and 50-year development strategies. By presidential order, the NRPB became an independent agency under the supervision of the White House in 1934 and would remain as such for the next decade.

In its early years the NRPB's work consisted primarily of fact-finding research and efforts to systematically catalogue the existing state of affairs for certain sectors or resources. The Board was made up of planners with backgrounds in conservation efforts and city planning, including

Frederic Delano, the President's uncle, and the city planner Charles Merriam. Some of the planners who led the First New Deal lamented its restricted scope: Tugwell, for example, characterized the Board's fact-finding work as "pre-planning."[xl] The domain of planners had shifted from comprehensive attacks on large-scale economic problems to the systematic consideration of more narrow problems. Still, the NRPB kept the concept of planning alive in the mid- to late-1930s as the New Deal changed course decisively. Merriam, the long-serving member of the Board most closely aligned with the central planning vision of the First New Deal, exerted increased influence over the NRPB's activities as the decade progressed. Under Merriam's influence, the NRPB helped preserve the notion that the economy itself, and in particular the industrial economy, was an appropriate and even necessary domain of government-led planning. Over these years the Board managed to hire for its temporary projects some of the leading proponents of central planning from the First New Deal, who found an outlet in NRPB's Industrial Section. Tugwell himself worked closely with the NRPB, leading some of its working groups on public works planning in the late 1930s and formally joining the NRPB's Land Committee in late 1941.[xli] And the leading figures on the NRPB clearly maintained an admiration for Tugwell and the early-New Deal planners, with Merriam referring to Tugwell on several occasions as "the rising sun."[xlii] Before the outbreak of WWII, the NRPB thus represented the remnant institutional voice for the New Deal planning tradition and remained a seed for its potential revival.

NAM and New Deal Planning

The New Deal planning tradition rose to prominence in the early 1930s and experienced a relative decline by the decade's end. It is useful at this point to take stock of how business leadership positioned itself in relation to New Deal planning. As the key voices of business interests and in particular those of the industrial sector during this period, NAM and the US

Chamber of Commerce (USCC) helped formulate a business consensus toward particular types of planning. That consensus, I suggest, was not consistently opposed to planning across the board. Though sometimes wary of the most radical conceptions of planning, NAM maintained a pragmatic stance, often voicing approval of the basic commitments of New Deal planning, and in particular cases, fully supporting and advocating for the expansion of planning mechanisms. To the extent that NAM opposed New Deal planning programs, the Association often did so due to specific features of those programs that threatened business interests; rarely did it oppose planning *qua* planning.

The onset of the Great Depression caught business leaders by complete surprise, as it did nearly all policymakers and attuned observers of the economic situation. Even after the financial collapse that initiated in late 1929, John Edgerton, then-president of NAM, believed the situation to be temporary, claiming, "I can observe little on the horizon today to give us undue or great concern."[xliii] USCC leadership agreed, denying that a full crisis would develop and interpreting the crash as an inevitable and momentary downturn. In 1931, the acting president of the USCC brushed off calls for reform, claiming "we have had at least seventeen of these cycles of depressions in the last 120 years."[xliv] The Hoover Administration intervened in a number of policy domains, including federal support for public works under the newly-created Reconstruction Finance Corporation (RFC), but these programs did not reach the scale necessary to halt the landslide. Hoover rejected the calls, now growing within the liberal wing of the Democratic Party, for immediate federal relief programs to combat joblessness and the growing hunger crisis. NAM leadership tended to agree: its president asserted in 1931 that "Many of those who are most boisterous now in clamor for work have either struck on the jobs they had or don't want to work at all, and are utilizing the occasion to swell the communistic chorus."[xlv]

In late 1931, with national unemployment reaching 20% and socialist organizing on the rise among workers, the attitude of NAM and other business leaders toward federal action to combat the crisis began to shift perceptively. Business leaders and organizations started to endorse certain limited forms of relief and public investment in order to trigger the beginnings of a recovery. Attitudes perhaps changed most dramatically toward economic planning and the potential for the federal government to carry it out. Planning, long the bugbear of business advocates and leaders during the 1920s, became an increasingly appealing fallback for business amid rapidly deteriorating investment conditions. In September of 1931, Gerard Swope, president of General Electric and a widely recognized voice of the national business community, publicly endorsed national industrial planning led by the federal government as a means to overcome the Depression. The "Swope Plan" advocated for a national planning structure based on self-governing industrial trade associations, which would coordinate production and work to stabilize prices, all under the monitoring of a federal planning mechanism. Antitrust laws would be amended and industrial firms cartelized, and in exchange for these pro-concentration interventions, participating firms would agree to higher wages, better working conditions, and an unemployment insurance scheme. This bore a striking resemblance to Tugwell's plan, though Swope envisioned a less powerful government planning agency.

National business organizations soon followed suit. In early 1932, the USCC elected Henry Harriman as its president in an attempt to moderate many of its previously held hardline stances. Harriman marked a particularly stark shift on the issue of planning, endorsing the USCC's version of the Swope Plan and announcing, "We have left the period of extreme individualism. Business prosperity and employment will be best maintained by an intelligently planned business structure."[xlvi] Like Swope, Harriman and the USCC envisioned a series of sub-industry organizations under the auspices of a national advisory economic council composed of industry and government leaders. If firms would not willingly participate in Harriman's plan, the system would resort to using coercive tax and regulatory levers: "mavericks" would be "roped, branded, and made to run with the herd."[xlvii] This new conception of industry-state relations, once unthinkable amongst business leaders, quickly earned the approval of the USCC and its members. By late 1932, a majority of the organization's member firms had endorsed Harriman's call for a planned industrial economy, and NAM soon followed suit.

In the leadup to the First New Deal, then, a marked shift on the concept of planning had taken place within influential national business circles—but how did business leadership react to New Deal planning in action? The supporting role of business in the establishment of the AAA is one major indication. While NAM was mostly uninvolved in agricultural policy—its membership being almost exclusively industrial firms—USCC leadership played a central part in both the initial design and eventual passage of the AAA. Even before Roosevelt's election, Harriman and the USCC met with influential proponents of a federally-controlled domestic allotment plan. During Roosevelt's campaign, Harriman met with Tugwell, the agricultural economist and Roosevelt advisor M.L. Wilson, and Roosevelt himself to discuss the details of a potential national plan for agriculture. During these meetings and others, Harriman made it clear to the incoming Roosevelt Administration that agricultural planning would receive the cooperation of the USCC.[xlviii] While Harriman and USCC leadership were decidedly supportive of the AAA, however, they lobbied heavily for business-friendly leadership of the Act's new central agency rather than Tugwell's liberal allies within the administration.

The national industrial planning architecture established by the NIRA commanded even greater participation and support from NAM. Immediately following his inauguration, Roosevelt started receiving letters from and met in person with a number of NAM and USCC representatives who urged him to relax antitrust restrictions on intra-industry cooperation and adopt an industrial reorganization plan. Initially resistant to the idea, Roosevelt became more sympathetic to industrial planning once he had observed the business community's support for it. While the NIRA was still being drafted, Roosevelt made an appearance at the USCC's annual conference and called on the organization's members to work with his administration "to prevent over-production, to prevent unfair wages, to eliminate improper working conditions."[xlix] A majority of the speakers at that USCC gathering acceded and publicly endorsed a move toward national planning of the industrial sector. Meanwhile, representatives from NAM had met with Assistant Secretary of Commerce John Dickinson to communicate their approval of some form of national planning and to try to influence NIRA's drafting in their favor. NAM's broad approval of the Act came as a great relief to the NRA's administrators, one of whom remarked that "it seemed as though a considerable part of the business world had 'got religion.'"[l] Following the NRA's establishment, NAM held a high-level meeting in late 1933 in which Robert Lund, the Association's sitting president, praised the Administration for bringing a new degree of cohesiveness to industrial business and saw opportunities for even further consolidation of the new trade associations under a new structure—headed, of course, by NAM itself.[li]

NAM leadership, however, did not approve of all of NIRA's features. While the organization was in broad support of the basic organizational infrastructure of the Act, including the cartelization of industry and the new powers handed to the NRA, it bitterly opposed inclusion of Section 7(a), the clause that compelled industrial firms to recognize unions and allow for collective bargaining negotiations. The USCC, more moderate than NAM during this period, begrudgingly accepted 7(a), a result of a truce the organization had reached with the American

Federation of Labor (AFL) earlier that year. NAM testified against 7(a) during Senate hearings on the draft bill, but the clause remained in the bill once it had gained the support of Southern Democrats, who had been assured by the Roosevelt Administration that the clause would not apply to agricultural workers.[lii] Despite NIRA's eventual demise, the spirit of 7(a) survived when Senator Wagner led the successful effort two years later to pass the NLRA, a move opposed by both the USCC and NAM. Ironically, the one feature of the NIRA that most aggrieved NAM was ultimately the Act's primary legacy.

The role of NAM in the development of the NIRA thus illustrates a central tendency in the relationship between business leadership and the First New Deal. Following the lead of the USCC, NAM did not universally oppose the New Deal during its planning-intensive phase; nor did the Association support the set of planning reforms in their entirety. Rather, NAM selectively backed the components of early New Deal reforms that were seen as being in its members' immediate interests. At the height of the crisis in 1933, those reforms included the major planning programs that sought deeper cooperation within industry competitors and between industry and the state. While NAM in large part supported these experiments in national planning, however, it remained deeply opposed to other types of reforms—the labor-strengthening clause of the NIRA being a prime example. But NAM, along with the USCC and other major elements of business leadership, perhaps reserved their greatest hostility for a separate reformist movement that gained increased stature once the planners had lost influence. Compared to its often pragmatic and occasionally sympathetic relationship to New Deal planning, NAM was far more disapproving of the neo-Brandeisian antitrust tradition, which will be discussed later in this chapter.

Industrial R&D and Planned Invention

By the mid-1930s, the New Deal planning approach, now in decline due to the failures of the NRA though kept afloat by Roosevelt's NRPB, soon had a new policy area to consider in addition to the standard list of natural resources, energy, and industrial capacity. By the start of the New Deal, private industrial research had reached a scale and position in the economy such that it could no longer be ignored by the planners. This was the culmination of a decades-long process that began in the late 19th Century, when a select group of emerging large corporations began to experiment with more regimented systems of invention. Reacting to developments in primitive electrical engineering and incandescent lighting, Thomas Edison established the first American corporate laboratory in Menlo Park, New Jersey and employed a permanent staff of research workers.[liii] Unlike earlier industries in which one-off breakthroughs by individual inventors could sustain technological advancement, the technological complexity of the burgeoning electrical industry required a more systematic approach. Edison believed this new system of routinized R&D would result in "a minor invention every ten days, and a big one every six months or so."[liv] By the 1890s, Edison's electric empire—now called General Electric—had come to dominate the new sector and established the more modern General Electric Research Laboratory in 1900. Others would soon follow suit: the chemical giant DuPont created its corporate laboratory in 1902, followed by AT&T, a subdivision of Bell Telephone in 1904. "Bell Labs" would epitomize the mature form of private industrial research for the next three decades.

U.S. Industrial Research Expenditures, 1920-1940[lv]

Year	Expenditures (in $1,000s)
1920	$ 29,468
1925	64,000
1930	116,000
1935	136,000
1940	234,000

By the 1930s, the corporate laboratory had become an essential feature of nearly all major industrial corporations in the US. What had begun as bold experiments in the electrical and communications industries was now a necessary business practice in all major subsectors of manufacturing, including chemicals, automotive, steel, and rubber. With critical support from the financial sector, corporate R&D expenditures increased dramatically during the 1920s and 30s (see table above). Invention itself had thus become more regimented, rationalized, and *planned* than it had been at any time in the history of capitalism.[lvi] Gone was the lone tinkerer, who in a flash of genius created new processes and devices that could be put to industrial uses; the new innovators were major institutions and organizations with large internal economies. Invention in all major areas of manufacturing was now under the control of corporate giants, which used R&D as a critical means of protecting their position in the market.

The arrival of large-scale industrial R&D and its obvious links with planning were not lost on some progressive and leftist thinkers. By the end of the 1930s, the British scientist and socialist intellectual J.D. Bernal published *The Social Function of Science*, the first major work suggesting that research itself should become a form of economic and social planning.[lvii] In a formulation reminiscent of Veblen, Bernal argued that the society's scientific and technological potential had been captured by industry, and that research could serve social goals more directly if it were freed from market-based structures and directed collectively. Lamenting that “the use that is made of science is primarily determined by its contributions to profit,” Bernal believed that the “full development of science” was “incompatible with the continuance of capitalism.”[lviii] The major industries had demonstrated that planned invention was possible and even necessary, and large-scale research could now be directed by the state:[lix]

> We have, in fact, to draw up a plan for science. At first sight the problem of the strategy of scientific advance seems insoluble. Science is a discovery of the unknown, is in its very essence unforeseeable, and a plan for its advance might seem, and has seemed to many, a contradiction in terms. But this is to take too far absolute a view; in fact, science could not advance at all unless it were to a certain extent planned...Our task is to put in its place a more consciously thought-out scheme which will, at the same time, take into account the unpredictable nature of scientific discovery.[lx]

For its part, NAM only began to focus on industrial research as a new area of policymaking by the late 1930s, having focused primarily during that decade on other forms of policy thrown into question by the New Deal. In early 1937, Karl Compton, now several years removed from his brief tenure on Roosevelt’s SAB, organized a meeting with NAM executives and several high-ranking members of the American Institute of Physics. Compton and his colleagues presented a new “Proposal for Science-Industry Relationship,” one that would increase NAM’s engagement with research laboratories of the major universities. The proposal cast research as a major oversight of NAM’s focus, particularly given the growing importance and rationalization of industrial research:

> In the past, industrial leaders have concerned themselves actively with problems of the nature of taxation, finance, law, economic development, labor relations and public relations. These are all important factors in the life of the nation. However, scientific and technological factors are of even greater importance in shaping the future course of national affairs especially within the manufacturing industries.[lxi]

Compton's group proposed that NAM form a new "Committee on Fundamental Scientific Research" that would "follow closely the developments in the field of scientific research and render occasional or annual reports to the members of the Association." NAM leadership took this advice to heart, and although it did not yet create a separate research-oriented committee, it retasked the existing Patents Committee to develop a new focus on research. For the first time, research had become a discrete policy area under NAM's purview. One year later, at another meeting between NAM executives and Compton's circle, the Association drafted a new policy statement aiming "to raise the standard of living and otherwise benefit society as a whole through increasing production and employment by means of a more widespread use of scientific research in industry."[lxii] Such a policy would be achieved through NAM's increased promotion of research as a profit-making tool for companies that did not already maintain research labs, and through expanded partnerships between university research groups and industry. In a preview of its alliances during the coming decade, NAM also began planning a conference on "How Research Can be Made an Increased Asset to American Industry," and proposed to invite MIT's Vannevar Bush as the featured speaker.

New Deal Planners Discover R&D

The most prominent New Deal planners, however, did not for the most part focus on innovation as a potential object of government planning, lagging behind European thinkers like Bernal and prescient business groups like NAM. The planners targeted industrial production that made use of already-existing plant and equipment, and mostly overlooked the continued transformation of technology—or in some cases even sought to curb that transformation. This attitude was directly linked to the broader economic context: unlike the high-speed growth environment of its New Nationalist predecessor in the early 1900s, the New Deal central planning tradition was forged in a deeply pessimistic period with respect to further technological transformation. The onset of the Depression elevated the interpretation, already developing prior to 1929, that the country had reached a state of "economic maturity," in which new industries and new markets would emerge at a decisively slower pace than in previous decades. The concept suggested that this plateau had been reached as a result of several interrelated barriers to further growth, including population size, geographic considerations, and perhaps most importantly, technological limits. This interpretation was convenient for those New Deal planners who understood the Depression as a supply-side crisis in need of rationalization and management. Tugwell, who foresaw "a state of stationary or even declining population within a few decades," framed his approach to planning in light of his observation that the nation was moving from a vast period of "economic development" to a permanent state of "economic maintenance."[lxiii] Likewise, Berle advised Roosevelt that the "economics of the future" would be less concerned with growth and more with the distribution and management of already existing resources.[lxiv]

The planning experiments of the First New Deal tended to reflect this pessimism toward technological development. During the early implementation phase of the NIRA, Karl Compton and Isaiah Bowman, two academic scientists who would later play pivotal roles in the government's WWII science mobilization, sought to include a Science Advisory Board (SAB) in each of the newly formed intra-industry associations. These SABs would advise the associations on issues involving technological innovation, which Compton and Bowman believed would be most pressing for "legacy" industries like textiles and steel that were often dominated by large incumbent firms.[lxv] Compton and Bowman's SAB was created in mid-1933, but it had no formal link to the trade associations established under NIRA, and had to settle for its more vague advisory role on science issues confronted by various executive branch agencies. Failing to establish R&D issues as key features of the industry codes, Compton turned instead to the new public works apparatus established under the NIRA. His campaign to "Put Science to Work" sought to recast R&D—and in particular, research conducted at universities—as a form of public works that could be supported by the NRA. This effort also failed, with NRA leadership casting R&D as outside the scope of the new agency's mandate.

The major exception to this trend was the TVA. Despite its limitations resulting from the bureaucratic struggles between Arthur Morgan and the Board, the TVA ultimately did turn to R&D as a key feature of its operations, more so than any other experiment in New Deal planning. The TVA's mandate called for direct research-based interventions, including "the operation of experimental plants on a larger scale than has ever before been undertaken in the history of the world, for the purpose of discovering new methods of production of fertilizers with the objective of cheapening the cost of fertilizers, not only to farmers in the Tennessee Valley, but everywhere in the nation."[lxvi] The TVA was thus granted the legal power to own and operate its own laboratories, to compel licensing of patents owned by private firms in designated technological fields, and to retain ownership rights over patents that it would develop in its own facilities. R&D at the TVA would yield some major successes: research conducted at the famous Muscle Shoals chemical plant, for example, produced breakthroughs in fertilizers and in their industrial-scale production techniques that had an immediate impact on agricultural productivity throughout the region. Additionally, the TVA developed several new farming tools, including harvesters, hay dryers, and storage freezers, which would be made available to farmers in the region. Marveling at the scientific achievements of the TVA, Stuart Chase noted in particular the value of government-owned patents: "The patents are held by the government, and the development will be non-profit government business...Dams, yes. But perhaps here is something more important."[lxvii]

In the latter half of the 1930s, when the scientific successes of the TVA caught the attention of New Deal popularizers like Chase, the topic of R&D began to be more closely examined by the remaining torchbearer of the planning tradition within the Roosevelt Administration, the NRPB. Ironically, as the actual influence of the planning tradition over national policy waned in the latter half of the 1930s with the New Deal's shift toward antitrust and Keynesian management, the NRPB sought to assert itself into national policy debates with increased confidence. With Charles Merriam exerting more influence over the Board during this period, the NRPB increased the scope of its work far beyond its initial focus on natural resources, and began to consider more ambitious political economy goals, including broad-based industrial planning and policies to maintain full employment and mass consumption. This would culminate in the early 1940s with the NRPB's turn toward developing a full set of American social welfare policies to compliment Keynesian counter-cyclical balancing. The resulting report, entitled *Security, Work, and Relief Policies*, served as the basis for Roosevelt's "Second Bill of Rights" outlining an aspirational set of economic and social rights for Americans.[lxviii]

It was during this newly ambitious period that the NRPB first considered the topic of R&D. In an exhaustive three-part series, collectively entitled *Research: a National Resource*, the NRPB surveyed the state of R&D across the economy, characterized the existing relationship between the government and research, and issued policy recommendations aimed at enhancing the nation's research effort. In 1935, the NRPB formed a Science Committee that included members of the National Academy of Sciences, the Social Science Research Council, and other organizations.[lxix] During its initial meetings, the Science Committee laid out the basis for a report on "long-range science planning" that would explore the possibility of "utilizing relief workers on research projects."[lxx] Two years later, the White House formally requested that the Board's Science Committee conduct a "study of Federal Aids to Research and of the place of research (including natural and social science) in the Federal Government."[lxxi] Roosevelt acknowledged in his request that "[r]esearch is one of the Nation's very greatest resources" and noted that "the role of the Federal Government in supporting and stimulating it needs to be re-examined." This was a request for a broad examination of what functions the federal government was currently undertaking to promote research and how those functions might be restructured.

During initial meetings of the Science Committee, it is clear that authors of the report considered the fragmentation and decentralization of the government's research efforts a major problem to be overcome. Acknowledging during these meetings that "there are many people in colleges scattered across the country who could contribute to cooperative research," Charles Judd, a leading author of what eventually became NRPB's final report, proposed as a solution "some central organizing agency which could gather up the materials collected by individual workers and combine these results into a large national research project."[lxxii] In Judd's view, "The Federal Government might conceivably be an organizing central agency for the stimulation as well as for the synthesizing of researches of the type to which reference is here made." Reflecting the views of the NRPB more generally, Judd's early framing of the problems addressed by the Science Committee suggested that "What this country needs perhaps more than anything else is to pool its energies under intelligent coordinating agencies."[lxxiii]

The board issued the first volume of the report, *The Relation of the Federal Government to Research*, in late 1938. This volume centered on federal research policy much more so than the latter two, which focused primarily on R&D conducted in the private sector and how federal policy could better support it. Characteristic of the NRPB's work at the time, much of the report's content was descriptive, offering a detached overview of research statistics and trends, as well as several case studies of successful government involvement in research. The report noted in particular that the government had in recent years "found it necessary to extend greatly the scope of its research program" in response to a series of problems, "such as those relating to agriculture, conservation of natural resources, and general economic conditions."[lxxiv] It included a comprehensive list of technical fields in which government research had come to play a prominent role, including defense, public health, and more recently, the physical and biological sciences.[lxxv]

Beyond this descriptive matter, the report included discussions of institutional design that anticipated many of the most contested federal innovation policy choices in the years—and even decades—to come. In several sections, the report endorsed a rather expansive justification of direct government promotion of R&D. Beyond its basic responsibilities for ensuring technological progress in areas vital to "national progress," such as defense and public health, the government should also intervene in any technical field in which the profit motive was insufficient in motivating private firms to bear the cost of R&D. The report thus advocated for what would later become the canonical "market failure" justification for federal R&D support:

> New lines of research are often expensive, and returns may be small or long delayed. Industry cannot afford to enter such fields unless there is reasonable prospect of definite financial gain within a predictable future; and it is under such circumstances that Government agencies may lead the way. When the pioneering work is done, industrial laboratories are established...and further refinements are made...Governmental research may thus be regarded as stimulating industry to enter new fields.[lxxvi]

The report identified several case studies that illustrate the potential for federal R&D to create new commercialized products and even entirely new industries—for example, the impact of the Navy Department on technological development in the steel industry. These cases demonstrated the government's potential to catalyze industrial innovation in contexts where returns to private firms were too distant. In addition to this temporal market failure, the report also identified situations in which the problem of *scale* tends to decelerate innovation—"fields in which the Federal Government seems to be the only agency with sufficient authority and resources to carry out an adequate research program."[lxxvii] The key example of such a case was the emerging commercial aerospace industry, with the National Advisory Committee for Aeronautics (NACA) serving as the critical force behind research in civil aviation technology, "a unique function which the Nation could not well do without but which is beyond the resources of any but a governmental institution."[lxxviii] Among all the cases of federal R&D programs investigated in the report, NACA stood out as a particularly successful effort.

Having established several justifications for government-led research, the report also examined the issue of institutional structure, returning in several sections to questions of centralization and coordination of the national R&D effort. Early on, the report points to the extensive research system positioned within the Department of Agriculture as an illustration of "complications arising from decentralization," which included a lack of systematic exchange of information between local offices and unproductive competition amongst these offices for access to central resources.[lxxix] Instead of this type of system, coordination of R&D led by the federal government offered several advantages:

> The authority, prestige, and resources of the Federal Government may be used to organize and direct research in any given field on a national scale to an extent impossible for any other agency. The value of such coordinated national research programs in time of war is obvious, but peacetime programs may also benefit from government leadership, which may be so applied as to sacrifice none of the freedom essential to scientific progress.[lxxx]

The report then discussed multiple cases of coordination that could already be identified in federal R&D programs, including certain functions within the Department of Agriculture and the industrial mobilizations led by the War and Navy Departments on an emergency basis. This discussion then turned back to the aerospace industry and NACA's institutional structure as a key example:

> In this field the Federal Government has exercised its leadership by setting up and liberally supporting a central research agency to "supervise and direct the scientific study of the problems of flight, with a view to their practical solution," and to "direct and conduct research and experiment in aeronautics." The method in this case is neither cooperation with non-Federal agencies nor a division of the field between Government and industry but amounts to a complete centralization of the function, under a committee representing both Government and industry.[lxxxi]

Building off this example, the report noted that the TVA had successfully built a similar type of centralized and coordinated research apparatus. Under the control of the Authority, "research in many fields, including both natural and social sciences, is carried on by a single agency and pointed toward a single goal."[lxxxii] Unlike NACA, however, the scope of the TVA's technological focus expanded well beyond a single industry: "The goal in this case is the planned development of a region rich in natural resources, with the research program designed to integrate social and technological advances."[lxxxiii] Both NACA and the TVA were thus pointed to in the report as examples that the government could effectively centralize and coordinate research, in both isolated fields and across several at once.

Having identified these possibilities for successful government coordination of R&D, the report's ultimate recommendation was for some form of increased coordination modeled after the Central Statistical Board, an agency created to centralize decision-making over statistical methods used across the executive branch agencies. Sub-boards would be created—one for each major branch of the sciences—and these would all report to some central federal research board that would seek to avoid duplicative or conflicting R&D projects, and to harmonize separate research programs into coherent directions.[lxxxiv] While the report did not explicitly promote NACA or TVA-style research planning for the entire federal system, it did firmly endorse the need for increased coordination and offered one possible institutional route for achieving it.

A final policy choice examined in the report was the issue of patent ownership. Noting that "there is no uniform policy on the part of the Federal Government with respect to patents growing out of the work of the research agencies," the report catalogued two divergent practices that had emerged across the government's R&D programs: the transfer of commercial patent rights to government employees or private contractors, as exemplified by the Army Signal Corps, and the classification of new inventions into the public domain for their free and open use, then a common practice of the Department of Agriculture:

> The various research bureaus of the Department have been responsible for a number of inventions; but these are invariably protected by public service patents for the free use of the public, or by patents assigned to the Secretary for manufacture under license but without charge. The employee responsible for the invention retains no rights in it and secures no compensation from it.[lxxxv]

The report identified weaknesses in both policies and chose not to endorse either one across the board. While the practice of transfer into private hands could help motivate government researchers, it also risked biasing them toward work that could be personally lucrative but not publicly beneficial. And while the report noted some successes of "public service patents," it also pointed out that private firms would often need guarantees of exclusivity in order to make investments toward commercializing them.[lxxxvi] Even though it did not take a side, advocating only that a "thorough study of the whole problem should be made," the report thus established federal patent policy as a critical policy choice in the design of federal research programs.[lxxxvii] Perhaps characteristic of the New Deal planning tradition more broadly, the report framed the patent ownership question only as a means to accomplish the goal of promoting innovation and did not consider alternative values and concerns linked to ownership.

While the report did not provoke the level of public response generated by its later pronouncements on social policy and employment, it did earn the endorsements of several members of Roosevelt's cabinet, including then-Secretary of Agriculture Henry Wallace. In developing its reports, the NRPB's Science Committee also actively sought out links with the business community: after issuing its first volume, the Science Committee reached out to Henry Harriman, former USCC leader and vocal proponent of national planning at the start of the New Deal.[lxxxviii] Importantly, the report also made its way into meetings of the NAM's Patents and Research Committee, which discussed the findings of *Research: A National Resource* on multiple occasions.

In the years leading up to WWII, the planning tradition was thus diminished from its status at the start of the New Deal but still active in institutions like the NRPB and in influential policy circles. While the architects of the key planning experiments of the early Roosevelt Administration largely ignored R&D, planners later on in the decade discovered research as a potential target of planning, one that could be organized in institutional structures and systems resembling those developed by the original New Deal architects. Business leadership, which had often maintained a pragmatic stance toward experiments in agricultural and industrial planning, appeared open to the possibility that a more coordinated and planned research system could work in their interests. It was not long before WWII radically scaled up the government's R&D effort and made renewed calls for research planning all the more pressing. But NAM and other business organizations then turned against R&D planning, not because their attitude toward planning had fundamentally changed, but rather because a separate reform tradition had come to influence progressive proposals for R&D policy that was seen as far less compatible with business interests. The discussion now turns to an overview of this tradition and its influence on the patent question.

"The Curse of Bigness": The Origins of Anti-monopolism

By the end of the 19th Century, the rapid growth of large industrial corporations, and the unprecedented personal fortunes of their leaders, began to challenge many basic liberal assumptions about the natural course of free market capitalism. While those touting the "New Nationalism" of Teddy Roosevelt sought to accommodate "bigness" and harness it for public advancement, others took a different course. Woodrow Wilson's "New Freedom" saw bigness as the enemy—as a threat to continued technological development, economic growth, and even to the maintenance of democracy itself—and turned to the federal government's newly established antitrust powers to combat it. Only when monopoly power had been sufficiently confronted—when behemoths like Standard Oil and US Steel had been broken up into smaller units—could American capitalism continue on its naturally competitive and progressive course.[lxxxix] The emerging problems at the heart of America's industrial economy thus produced two wildly divergent reform traditions: on one side, the tradition of "concentration and control," later spearheaded by the New Deal planners, and on the other, the trust-busting progressivism of Louis Brandeis and his followers.

Already an established consumer protection lawyer by the start of the Wilson Administration, Brandeis came to national prominence as a key advisor to Wilson and helped popularize the "curse of bigness" ethic among a new generation of reformers. For Brandeis, monopoly power was the fundamental problem of the new industrialized economy; big business thwarted growth, suppressed new innovation, and sought to capture the political system and use it to entrench its own power. Even worse, the emergence of corporate giants also opened the door to socialism by consolidating productive capacities to such a point that state ownership became feasible:

> Just as Emperor Nero is said to have remarked in regard to his people that he wished that the Christians had but one neck that he might cut it off by a single blow of his sword, so they say here: 'Let these men gather these things together; they will soon have them all under one head, and by a single act we will take over the whole industry.'[xc]

Brandeis viewed the middle ground of careful government-led regulation of large industry as unworkable due to the chronic threat of capture: "remedial institutions are apt to fall under the control of the enemy and to become institutions of oppression."[xci] The modern state, for Brandeis, should therefore avoid attempts to regulate industries and firms in their normal courses of action, and should instead concern itself only with preserving "industrial liberty" in the form of competition. However, in those rare situations in which concentration could not be avoided—for example, industries with "natural monopolies" such as railroads or energy utilities—industry should be "owned by the people and not by the capitalists."[xcii] State monopolies were superior to monopolies owned and controlled by private interests: while there was at least some chance that government-owned industry could operate in the public interest, the private trusts could never be counted on to do so. These were the basic commitments championed by Brandeis and his allies, whose advocacy efforts during the early Wilson Administration culminated in the Clayton Antitrust Act of 1914.

In terms of their basic framing of the issues plaguing American capitalism and the solutions to countering them, antitrust progressives were in deep and obvious conflict with promoters of the planning fix. For followers of Brandeis, competition between small-scale units in the market—the baseline of capitalism's "normal" course of development—could be relied upon to generate consistent innovation and distribute its benefits in a just fashion. Capitalism could be thrown off its progressive course only through nefarious manipulation, usually by corrupt business magnates and financiers. Planners, in contrast, tended to view competition as the problem—the chief source of market anarchy that led to waste and crisis-prone overproduction. In the early 1900s, industrialist and central planning advocate George Perkins accused trust-busters of seeking to roll back progress: "The entire path of our industrial progress is strewn with the white bones of just such competition...The Congressman who stands for a literal enforcement of the [antitrust laws] stands for the sweat shop and child labor."[xciii] Brandeis observed the intellectual divisions between these two camps as "fundamental and irreconcilable."[xciv] But in practice, the two traditions were often synthesized by political leaders who borrowed from both pragmatically. Teddy Roosevelt championed his New Nationalism while also seeking to break up many of the country's largest corporate monopolies, and the trust-busting Wilson created a number of transformative federal regulatory agencies, including the Federal Trade Commission (FTC) and the Federal Reserve.

Brandeisian reformism, as with the progressive planning tradition, faded during the decade of "business rule" in the 1920s but soon experienced a revival with the onset of the Depression and the ensuing search for new policy solutions. In the runup to the 1932 election, trust-busters and planners competed for influence over Roosevelt, who maintained his characteristic distance from any one school of thought. Tugwell and Berle, having gained insider status from the early days of the campaign, sought to steer Roosevelt away from the "old fashioned progressivism" that they viewed as deeply mistaken.[xcv] Felix Frankfurter, a nationally prominent disciple of Brandeis, quickly captured Roosevelt's attention on the campaign trail and urged him to resurrect the antitrust fervor: “Felix has more ideas per minute than any man...I find him tremendously interesting and stimulating.” Tugwell lamented Frankfurter’s increased access to Roosevelt, and after a Roosevelt campaign speech criticizing corporate concentration, declared that his candidate had “returned to trust-busting and began to abandon the struggle for conjuncture.”[xcvi]

Tugwell’s concerns were overstated; he and his cohort of planners would go on to dominate the early phase of the New Deal and see many of their institutionalist ideas put into practice. Still, antitrust progressives made some initial inroads with the Roosevelt Administration, particularly in the field of financial regulation. The 1933 Securities Act and subsequent legislation sought to combat financial misdealing and concentration, but did not advance the government-finance partnerships advocated by Tugwell and Berle that would direct investment toward any particular goals. William O. Douglas, then a political ally of the planners, described the Act as “a nineteenth century piece of legislation...of a decidedly secondary character”—these victories of the Brandeisians were “wholly antithetical to the programme of control envisaged in the New Deal and to the whole economy under which we are living.”[xcvii]

The Neo-Brandeisians and the Second New Deal

Eventually, the New Deal’s antitrust moment would come. By 1935, the status of the planning idea, and of its promoters within the Administration, had been reduced dramatically. A marked shift then took place in intellectual inspiration, programmatic commitments, and most importantly, personnel. The planners had exited the inner circle of New Deal policymaking, replaced by a new cohort of “neo-Brandeisians” seeking to revive competition and by more conservative, proto-Keynesian advocates of government spending. Schlesinger characterized this shift as follows:

> The effort of 1933 had been to reshape American institutions according to the philosophy of an organic economy and a coordinated society. The new effort was to restore a competitive society within a framework of strict ground rules and on the foundation of basic economic standards — accompanied, as time went on, by a readiness to use the fiscal pulmotor to keep the economy lively and expansive.[xcviii]

For their part, the neo-Brandeisians pushed Roosevelt to ramp up the efforts of the Department of Justice in enforcing the Sherman and Clayton Acts. With these programmatic changes came a new rhetorical combativeness from Administration leaders and from Roosevelt himself. Decrying the efforts of "economic royalists" to sabotage the New Deal and send the country spiraling back into a new depression, Roosevelt made the concentration and abuse of economic power the core message of his 1936 reelection campaign.[xcix] Abandoning his earlier commitment to business-government collaboration and planning, Roosevelt became a staunch critic of monopoly by the end of his first term, focusing in particular on concentrated power in the industrial and financial sectors. Writing to an advisor in 1936, Roosevelt stated that "the real truth of the matter is...that a financial element in the larger centers has owned the Government ever since the days of Andrew Jackson...The country is going through a repetition of Jackson's fight with the Bank of the United States—only on a far bigger and broader basis."[c] Roosevelt and his advisors would eventually blame the 1937 "Roosevelt Recession"—now recognized as a product of the Administration's failed attempts at balancing the budget—on a conspiratorial "capital strike" led by the nation's leading monopolies. In a 1937 address, Roosevelt laid out his argument:

> Among us today a concentration of private power without equal in history is growing. This concentration is seriously impairing the economic effectiveness of private enterprise as a way of providing employment for labor and capital and as a way of assuring a more equitable distribution of income and earnings among the people of the Nation itself.[ci]

Once a cooperative—though always tentative—partner in early New Deal programs, business leadership responded to this newfound hostility in kind. In 1935, Irénée du Pont, scion to the chemical manufacturing giant, wrote to his business allies that "large businesses followed the President in the belief that he was sincere and that experiments which he might initiate would be discarded if they were unsuccessful." But in light of the policy failures of the First New Deal and turn against big business in its aftermath, du Pont believed "[i]t must have now become clear to every thinking man that the so-called 'New Deal,' advocated by the Administration, is nothing more or less than the Socialistic doctrine called by another name."[cii] Aiming to combat the Administration's new antitrust challenge and roll back the New Deal's recent advances in labor protections and social welfare programs, du Pont and fellow business leaders formed the American Liberty League, an organization that would serve as the center of conservative business efforts during the Second New Deal. The League's membership included several of the nation's most influential business leaders, including the presidents of industrial R&D giants like General Motors and Eastman Kodak. Ultimately, the League's short-term goal mission of ousting Roosevelt in 1936 floundered. Roosevelt and other leading New Dealers dubbed the League the "Millionaires Union" and portrayed it as emblematic of the social and economic ills that had driven the country into depression in the first place.[ciii] Indeed, Roosevelt's entire reelection campaign centered on an attack on the League and the big business interests that it plainly represented.[civ] Roosevelt defeated his League-backed Republican opponent in a landslide, further emboldening the neo-Brandeisians within the Administration.

Though the American Liberty League failed to halt the momentum of the New Deal, the attempt itself signified a marked shift in the relationship between business leadership and the Roosevelt Administration. While the planners of the First New Deal saw big business as a necessary if somewhat untrustworthy ally, the trustbusters of the Second New Deal saw only an enemy. Neo-Brandeisians had viewed the major planning experiments of the AAA, NIRA, and TVA as hopelessly prone to industry manipulation and capture, in addition to technically infeasible. The perceived failures of those experiments reaffirmed the commitment to combating concentration rather than cultivating it. Similarly, business leadership largely abandoned its conciliatory position toward the New Deal in its early years and launched an open political assault against Roosevelt and his allies. A key terrain in this battle would be corporate research and control over patents, which had in the leadup to the New Deal become a central feature of monopoly power.

The Patent Power

From its origins, industrial R&D was always linked to monopoly. As David Noble suggested, only the capitalist enterprises that had achieved a certain scale and insulation from fierce market competition were able to commit the necessary resources for substantial internal research capacity. The early experiments in large-scale in-house research capacity led by General Electric and Bell, as noted above, went hand-in-hand with the aggressive accumulation and enforcement of patents to ensure market dominance. Indeed, Edison and his partners actually founded General Electric in the first place to overcome a patent-based impasse resulting from competition between Edison General Electric and the emerging electrical industry powerhouse Thomson-Houston. The 1896 merger allowed Edison's research laboratory to pursue new lines of research without the concern over patent-based lawsuits brought by its former competitor. However, General Electric soon faced new competition from Westinghouse, and the rivalry between the two corporations intensified and resulted in hundreds of patent lawsuits that threatened to slow expansion. Rather than merge the two completely, however, the two electrical giants simply decided to share patents by forming a patent pool, in which each could draw freely from the patent inventory of the other. Noble has argued that these two corporations

> monopolized a substantial part of the American electrical manufacturing industry, and their success and expansion had been in large measure the result of patent control. In addition to the original patents upon which the companies were established, they had gained control over others, and hence over large parts of the electrical manufacturing market, through acquisition of competing firms, mergers with competitors, and the systematic and strategic development of their own patentable inventions.[cv]

Bell Telephone's monopolization of the communications industry through aggressive patent strategies was even more blatant. Even before the firm's founding, Alexander Graham Bell had created the Bell Patent Association, the "nucleus of the first Bell industrial organization" and the initial source of assets for the firm. As early as 1879, Bell leadership had established a patent department, whose sole purpose was to constantly survey the field in search of new patents for the firm to acquire and use to stave off competition. In the words of Bell executive Theodore Vail, "we recognized that if we did not control these devices, somebody else would."[cvi] By 1890 Bell Telephone had filed six hundred infringement suits in order to prevent competitors from emerging. At a certain point, the significance of patent considerations to Bell and its offshoots' research strategies had reached such an extreme level that the firms' patent attorneys themselves were exerting meaningful control over the research process. In his history of Bell's R&D program, Leonard Reich observed that

> Patent Department attorneys were in close contact with research. They often came to the laboratory to speak with the staff and help decide what work should be submitted for patent coverage. The attorneys sometimes suggested further research that would be likely to yield valuable patents and also proposed follow-up work to substantiate submitted patent claims...Thus, the patenting process was fully integrated into the laboratory's research efforts.[cvii]

The significance of patent monopolies in industrial R&D continued to grow in the early decades of the 20th Century, and increased dramatically as a result of WWI. The American chemical industry had lagged behind the German chemical conglomerates, which had long benefited from a close relationship with state-sponsored chemical engineering laboratories and universities. After the war, the US government seized all German-owned patents through the Alien Property Custodian and auctioned these patents to American companies. The highest bidders were naturally those firms with the most resources, and so the US government was effectively "replacing the German monopoly with the American monopoly."[cviii] Firms like DuPont, Eastman Kodak, and Union Carbide—each already rapidly expanding by merging with smaller competitors—all received licenses on hundreds of German patents. American chemical R&D had finally come to dominate the world.

These monopolistic practices were abetted by developments in American patent law during this period and an extraordinarily permissive posture by the courts toward the claims of large industrial firms. Courts exhibited "disregard for, or approval of, monopolies based upon patents" into the l890s, even though the emerging patent trusts were clearly a far cry from the early justifications of patent protections, which sought to protect the lone inventor from the threat of free-riders. The first three decades of the 20th Century saw a continuation of this approach despite the emergence of the antitrust movement and the explicit recognition by the 1914 Clayton Act of abusive patent practices as a form of anti-competitive behavior.[cix] During this same period, reforms to the patent system that expanded the requirements for patent filing and accompanying fees had the effect of shutting out "tinkerers" and small companies from acquiring patent protections. Noble summarized this development as follows:

> The successful reform efforts between 1900 and 1929, while they had to be buttressed by subsequent measures in the wake of ever-expanding patent demands, brought the American patent system more closely into line with the needs of corporate industry. They set the basis for a "formalism" in the handling of patents which progressively eliminated the individual inventor, who, unlike the large corporations with their well-staffed legal departments, was not equipped to cope with its intricacies and complexities.[cx]

Importantly, industry leaders and corporate lawyers of this period clearly recognized the anti-competitive nature of industrial patent practices. In the mid-1900s, the patent lawyer Edwin Prindle, who had, while consulting for several industrial conglomerates, pioneered the practice of corporate ownership of employee-generated inventions, published a popular pamphlet series entitled "Patents as a Factor in a Manufacturing Business," in which he offered firms advice on how to exploit patent rights in creative ways to gain market advantage. Prindle had based his advice on his experience working with and observing the practices of Bell Telephone, GE, Westinghouse, and United Shoe. Summarizing his perspective, Prindle suggested that

> Patents are the best and most effective means of controlling competition. They occasionally give absolute command of the market, enabling their owner to name the price without regard to cost of production...Patents are the only legal form of absolute monopoly.[cxi]

Thurman Arnold and the Assault on Patents

These practices finally came under attack as the New Deal shifted focus toward antitrust policy in the late 1930s. By Roosevelt's reelection in 1936, the antitrust crusade had become the most salient feature of the New Deal, due largely to the growing public prominence of the newly reinvigorated Antitrust Division and its ardent leader, Thurman Arnold. Once a critic who described the antitrust laws as "the greatest protection to uncontrolled business dictatorships" due to their inadequacy to deal with actual barriers to competition, Arnold relished his new position as

Department of Justice (DOJ) Antitrust chief in 1938, launching an unprecedented number of investigations and lawsuits to break up corporate power. Under Arnold's leadership, the annual number of new antitrust cases opened by the DOJ increased from 11 in 1938, to 92 in 1940, and nearly every case that reached a trial was won. The DOJ now sought harsher penalties, demanding that corporations pay fines and fundamentally reform their business practices rather than just abandon the anticompetitive violations they had committed, which had been the DOJ's usual practice up to that point. Arnold also pursued innovative theories of monopolistic behavior, dramatically expanding the forms of business practices that the DOJ would pursue under the antitrust provisions. For example, he launched a series of "industry-wide" investigations aimed at "prosecuting simultaneously all of the restraints which hamper the production and distribution of a product from raw material to consumer."[cxii] Monopolistic practices were no longer confined to the shadowy practices of isolated, large corporations—they could be found in firms of all sizes and in their intricate business relationships.

Arnold's innovative approach to antitrust enforcement stemmed from his unorthodox interpretation of the Brandeisian framework. Unlike Brandeis and many of his most avid followers, Arnold did not see "bigness" itself as the problem. Rejecting the notion that "bigness is a curse in itself," Arnold believed that the country's new "mechanized age" required big business, along with "its research, its technicians, its production managers." "As a generalization," Arnold claimed, "it is as meaningless to say that small units are better than big units as to say that small buildings are better than big ones." The Brandeisian impulse would need to be updated to deal with these modern conditions. Instead of maintaining a generalized assault on bigness, the state would need to carefully police a constantly-evolving set of monopolistic practices carried out by firms of all sizes.

One of the most noxious of these practices, Arnold and his team concluded, was the abuse of the patent system.

Many of the most hardline antitrust advocates of this era took issue with the very concept of the patent—though temporary, patents were, after all, government-sanctioned monopolies. Brandeisians of the Progressive Era had considered domination of an industry through patent control an especially insidious form of monopoly—a "monopoly of monopolies," in the words of an observer in 1915.[cxiii] Writing in 1938, the Brandeisian legal scholar Mortimer Feuer pointed to intellectual property as "the greatest single monopolistic device" plaguing the contemporary American economy. Arnold and his Antitrust Division were particularly sensitive toward patent issues, and launched a multi-pronged attack against what they saw as the most egregious anticompetitive practices linked to patents across many industries. Arnold scored an early victory in *Ethyl Gasoline v. US*, in which the Supreme Court halted certain practices of "restrictive licensing," which large firms such as DuPont, General Motors, and Standard Oil had employed to limit the business options of their licensees in a number of critical ways. *Ethyl Gasoline* was followed by *Hartford-Empire Co. v. US*, another high-profile case that successfully broke up a patent pool used by a cartel of glass makers to exert control over the entire industry. The Antitrust division would launch over twenty of these patent-antitrust lawsuits. Many of the most aggressive patent practices that helped pave the way for modern industrial R&D were now under attack.

In his 1940 book *The Bottlenecks of Business*, Arnold laid out his fully developed intellectual approach to antitrust issues and made clear that patent abuses were among his top priorities. Patent rights were used by powerful corporations in combination with other legal privileges to form "a sort of barbed-wire entanglement" to prevent the antitrust laws from maintaining market competitiveness.[cxiv] When corporations hoarded patents and used them in an "offensive" manner—to preempt would-be competitors from entering the same markets—the patent privilege amounted to "a cartel with dictatorial powers" that only served to lock in incumbent industry advantage. Citing the example of the glass maker Hartford-Empire, Arnold sketched out how patent rights could now be used to manipulate supply-side behavior across an entire industry:

> By the skillful use of its patents Hartford-Empire determined who could go into business and who must keep out. It determined who could manufacture bottles, what type of bottles they could manufacture, and in what quantities. It determined in what areas they could do business...It exercised its power by threats, backed by the showing of its great resources.[cxv]

Arnold's substantial victories in the courts were highly publicized, and helped bring problems of patent abuse into the mainstream policy debates and legislative proposals. In 1938, while Arnold was beginning his patent battle, Roosevelt created the Temporary National Economic Committee (TNEC), a broad investigatory body tasked with examining the causes of the Depression and the still-remaining barriers to a full recovery. Staffed heavily with elite lawyers from the Brandeisian tradition, and in frequent contact with Arnold himself, the TNEC made the patent system one of the primary targets of its investigation. The TNEC focused on patents during its very first hearings in late 1938, drawing directly from Arnold's work in its denunciations of patent cartels in the glass and automobile industries. Though the Committee did not ultimately issue many concrete policy recommendations, their investigation was a clear sign that patents had become a major focus of the Second New Deal's antitrust wing.

The TNEC's 1940 report *Patents and Free Enterprise*, one of several monographs released in the series *Investigations of Concentration of Economic Power*, summarized much of the thinking that had been developed by this new neo-Brandeisian turn in patent debates. In this report, the TNEC defended the basic principles of the patent system but described a number of glaring weaknesses and inefficiencies that needed to be rectified by new policy. Chief among these was the rise of corporate patent hoarding, which tended to stifle innovation over the long run and shut out innovative newcomers. “The grant of a patent is intended to protect an invention,” the reports authors noted, “but in practice it repeatedly operates to block off a whole technology.”[cxvi] Key features of the contemporary patent system, including the excessive length of patent protections, the number of new fields covered by intellectual property, and the abilities of large corporations to abuse the system for its own ends had resulted in a system that no longer achieved its stated purpose of promoting invention:

> Thus it has come about that a patent is harnessed to causes it was never meant to serve...The net result is a strange anomaly within a democracy. An industry is removed the control of the market and no substitute is provided for its protection which has been forfeited. There emerges an industrial province completely independent of the authority of the Government...In such employment a wayward patent system has strayed far from the office to which it was appointed by the Constitution.[cxvii]

For the authors of the report, what made this behavior all the more egregious was that in the contemporary context, private innovators led by the profit motive were no longer the driving force behind the most transformative R&D successes. Citing the NRPB’s report on the nation’s R&D resources, the TNEC noted that “the conditions of invention have radically changed...The pioneer work is now largely done in laboratories and workshops, maintained by the Government, by universities, by foundations.” In these circumstances, in which innovators “respond to no immediate stimulus from the patent system or from the urges toward money-making,” the traditional rigidity of the patent system could no longer be justified.[cxviii] In light of these changed conditions, the TNEC proposed that the system be modernized to prevent corporate abuses and to revive the patent system's original purpose.

The report called for the selective shortening of patent terms and an expanded mandate for the Patent Office to carry out a broad "national technology policy."[cxix] The TNEC's final recommendations on patent reform, issued in March of 1941, went much further than those in the report. Concluding that "in many important segments of our economy the privilege accorded by the patent monopoly has been shamefully abused," the TNEC issued a number of far-reaching reforms to the system, including a compulsory licensing requirement on all new patents. This would prevent patent holders from restricting licensing of their patents to certain buyers and would essentially place all patents into the public domain with state-determined royalties. Additional proposals included measures to restrict the number of suits for patent infringements "to prevent the use of litigation as a weapon of business aggression rather than as an instrument for adjudicating honest disputes" and a new limitation on the period of patent protections.[cxx] Though these proposals were not implemented, the TNEC's investigations and ultimate recommendations bolstered the emerging consensus that the American patent system was primarily functioning in the service of corporate profits rather than technological development.

In combination, the growing patent-antitrust assault in the courts and the increasingly public investigations of many of the most fundamental features of American patent law worked to put national industrial business leadership on the defensive. NAM had initially sought cooperation with the TNEC's patents investigations, sending NAM-produced data and reports to the Committee in late 1938.[cxxi] During a late 1939 meeting of the Patents Committee, NAM members all accepted the new reality "that patents now are subject to the anti-trust laws," and the Committee took no immediate action in response.[cxxii] By 1940 however, NAM's leadership on patent issues had interpreted these shifts as amounting to a full-scale "attack on the United States Patent System," one that sought changes "so drastic as to destroy the very fundamentals upon which it was founded."[cxxiii] In order to combat these efforts, NAM established a "Patents Fund" that would support a number of new NAM-allied research program—envisioned as industry's version to the TNEC and NPPC—as well as a series of public relations campaign on the patent system designed to counter progressive attacks. The centerpiece of that campaign, a series of "Modern Pioneers" dinners, celebrated the 150th anniversary of the Patent Act of 1790, the legislative origin of American patent law.

Heading NAM's new patents research program was the lawyer George Folk, on whom NAM would come to rely for a number of years on patent law and policy issues. Folk's work in the early 1940s resulted in the NAM-sponsored monograph *Patents and Industrial Progress*, framed as a pro-industry response to mounting progressive critiques, particularly that of the TNEC. Folk asserted that the testimony prepared for the TNEC's patent hearings "had such erroneous and prejudiced views regarding the rights granted by a patent and the relation of the patent monopoly to the antitrust laws, that the committee was given a perverted and one-sided picture" of the patent system.[cxxiv] This resulted, in Folk's assessment, in a TNEC report on patents that wildly misrepresented basic facts about the patent system and over-exaggerated its problems. The author of the TNEC report, Folk claimed, "evidently has little respect for property rights in the hands of corporations, and still less for patents so held, regarding the latter as a vicious monopoly 'staked out in the public domain,' from which both the independent inventor and 'free enterprise' are excluded."[cxxv] The TNEC's proposals for reform of the patent system amounted to an "eradication" of the patent system "by enemies of private ownership of property, especially of patents, who seek an economic revolution and would subject the patent system to bureaucratic control."[cxxvi] NAM had made clear that the Association thoroughly rejected the approach and recommendations issued by the TNEC.

From statements made during meetings, it is also clear that NAM leaders took Arnold to be a particularly dangerous figure threatening the foundations of patent law and therefore of industrial business as well. NAM's leadership on patent issues had concluded that Arnold and his division were fundamentally "anti-patent," and had proposed a series of reforms "calculated in the main to sabotage the patent system."[cxxvii] At a special "Patents Luncheon" arranged to discuss Arnold's recent court victories, a NAM member objected that "The anti-trust laws of this country are sufficiently comprehensive in their scope to prevent most of the practices against which Thurman Arnold complains." What was called for were careful and piecemeal reforms to the patent system, rather than "striking the American patent system with a meat cleaver," as Arnold had seemed to promote.[cxxviii] At a large gathering of the NAM Patents Committee in early 1942, including representatives from DuPont and other major industrial firms, NAM's key advisor on patent issues concluded that based on Arnold's recent legislative testimony, it could be inferred that their position was "that patents are not property and hence may be condemned by the government without provision for just compensation to the patent owner."[cxxix]

NAM and Public R&D in the Lead-up to WWII

NAM's fears were overstated. Despite Arnold's successes in the courts, the investigations led by the TNEC failed to trigger any major legislative change in patent law. With the onset of WWII, the momentum of the neo-Brandeisians within the Roosevelt Administration began to ebb. Though Arnold and his DOJ successor maintained their attempts to curb monopolistic practices, the political support behind antitrust progressivism waned as the war mobilization ramped up. Despite the efforts of the remaining New Dealers within the administration to structure the war mobilization along progressive economic lines, it quickly became clear that the rearmement effort would be a massive boon to industrial firms. Efforts of the neo-Brandeisians to curb abusive patent practices during the war were thwarted by resistance from the newly created War Production Board, citing military exigencies as the overriding concern of the moment. Though they continued to score some minor victories during the war, antitrust progressives had lost their status as the new torchbearers of reform—Roosevelt, famously, had transformed from "Dr. New Deal" into "Dr. Win-the-War." The Second New Deal had come to an end.

The war would fundamentally transform American political economy. War production delivered an economic miracle to the domestic economy, with full-scale mobilization after Pearl Harbor immediately lifting the American economy out of recession and generating full employment by the end of 1942. The war would also test the nation's peak scientific capacities, directing the collective R&D resources situated in private firms, universities, and government laboratories toward new military applications that could be quickly utilized in combat. In the process, R&D in the US was revolutionized, with the federal government stepping in as the nation's chief promoter of science and research. This shift brought with it a host of pressing questions of institutional organization, and a debate soon emerged over how to structure public R&D—a debate that led NAM to formulate its own positions on the role of government in R&D.

This chapter has aimed to characterize the positioning of NAM and other key elements of national business leadership in the period leading up to that monumental shift. By the mid-1930s, the two leading reformist movements with the greatest bearing on research, New Deal central planning and neo-Brandeisian anti-monopolism, had both set their sights on the nation's R&D capacity as a new target of policy. While the planners saw the rise of large-scale industrial R&D as an opportunity for state-led coordination, much as they did with "bigness" in general, the antitrusters saw monopolistic patent abuses, which they sought to curb. On the eve of the wartime R&D revolution, it was overwhelmingly the latter reformist tendency that most threatened NAM. The Association evinced a pragmatic openness toward certain ideas about a more coordinated industrial economy, including some of the hallmark experiments in national planning during the first New Deal, and was untroubled by the NRPB's brief foray into research as a subject of planning. The neo-Brandeisian assault on patents led by Thurman Arnold, however, was far more worrisome. This concern would only grow as the government dramatically scaled up its research capacities at the outbreak of war.

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[i] Schlesinger, Arthur Meier., and Franklin Delano Roosevelt. *The Crisis of the Old Order 1919-1933*. 1957, at 20-21.
[ii] Richard, Van Hise Charles. Concentration and Control: a Solution of the Trust Problem in the United States. Macmillan, 1912.
[iii] Dewey, John. *Individualism, Old and New*. Capricorn Books, 1962. Reprint; Dewey, John, and Irwin Edman. *John Dewey: His Contribution to the American Tradition.* Greenwood Press, 1976. Dewey, John, and Irwin Edman. *John Dewey: His Contribution to the American Tradition.* Greenwood Press, 1976.
[iv] Veblen, Thorstein Bunde. *The Theory of Business Enterprise*. Routledge, 1994. Reprint; Veblen, Thorstein. *The Engineers and the Price System*. The Viking Press, Inc., 1940; Camic, Charles. *Veblen: the Making of an Economist Who Unmade Economics*. Harvard University Press, 2020.
[v] On the price system: "In any community that is organized on the price system...habitual unemployment of the available industrial plant and workmen, in whole or in part, appears to be indispensable condition." Id.
[vi] Berle, Adolph A., and Gardiner C. Means. *The Modern Corporation and Private Property*. Transaction Publ., 2010. Reprint.
[vii] *Id.*
[viii] Sternsher, Bernard. *Rexford Tugwell and the New Deal*. Rutgers University Press, 1964.
[ix] *Id.* at 93.
[x] Tugwell, R. G. "The Principle of Planning and the Institution of Laissez Faire." The American Economic Review, vol. 22, no. 1, 1932, pp. 75–92. JSTOR, www.jstor.org/stable/1813950.
[xi] Sternsher at 89.
[xii] Tugwell (1932) at 90.
[xiii] Tugwell, R. S. *The Industrial Discipline and the Governmental Arts*. 1933.

[xiv] *Id.*
[xv] Schlesinger (1957) at 214-215.
[xvi] Foster, William Trufant, and Waddill Catchings. *Business without a Buyer*. Houghton Mifflin Company, 1928; Foster, William T., and Waddill Catchings. *The Road to Plenty*. Mifflin, 1928.
[xvii] Schlesinger (1957) at 134-35.
[xviii] Letter, Tugwell to Harold L. Ickes, 1941; cited in Russell Lord, "Governor Rex of Puerto Rico," *Common Sense*, July, 1942, 28. Cited in Shernster, *Rexford Tugwell and the New Deal*, page 99.
[xix] Shernster 99-100.
[xx] Schwarz, Jordan A. *Liberal: Adolf A. Berle and the Vision of an American Era*. Free Press, 1987, at 37.
[xxi] Soule, George. *Toward a Planned Society*. 1933.
[xxii] Schlesinger (1957) at 135.
[xxiii] Maher, Neil M. *Nature's New Deal: the Civilian Conservation Corps and the Roots of the American Environmental Movement*. Oxford University Press, 2010.
[xxiv] Schlesinger (1957) at 392.
[xxv] *Id.* at 421.
[xxvi] *Id.*
[xxvii] Schlesinger, Arthur M. *The Coming of the New Deal*. Houghton Mifflin, 1959, at 39.
[xxviii] *Id.* at 46.
[xxix] *Id.*
[xxx] *Id.* at 73.
[xxxi] *Id.*
[xxxii] "May 7, 1933: Fireside Chat 2: On Progress During the First Two Months." *Miller Center*, 26 Apr. 2017,millercenter.org/the-presidency/presidential-speeches/may-7-1933-fireside-chat-2-progress-during-first-two-months.
[xxxiii] Taylor, Jason E. *Deconstructing the Monolith the Microeconomics of the National Industrial Recovery Act*. The University of Chicago Press, 2019.
[xxxiv] Schlesinger (1959) at 110.
[xxxv] Riggs, John A. *High Tension: FDR's Battle to Power America*. Diversion Books, 2020.
[xxxvi] Schlesinger (1959) at 327.
[xxxvii] *Id.* at 330.
[xxxviii] Riggs (2020); Schlesinger (1959).
[xxxix] Originally called the "National Planning Board" when first created as part of Works Progress Administration.
[xl] Schlesinger (1959) at 351.
[xli] Box 16 Folder 10, Tugwell Papers, Franklin Delano Roosevelt Library.
[xlii] Box 17, William F. Ogburn Papers, University of Chicago Archive.
[xliii] Schlesinger (1957) at 177.
[xliv] *Id.* at 178.
[xlv] Schlesinger (1957) 178-79.
[xlvi] *Id.* at 182.
[xlvii] *Id.* at 182-3.
[xlviii] Domhoff, G. William, and Michael J. Webber. *Class and Power in the New Deal Corporate Moderates, Southern Democrats, and the Liberal-Labor Coalition*. Stanford University Press, 2011.

[xlix] Schlesinger (1959) at 98.
[l] *Id.* at 99.
[li] Notes on Meeting of Trade Associations Held Under the Auspices of National Association of Manufacturers. October 31, 1933. 1411 Box 191. 2020.293. NAM Collection, Hagley Library.
[lii] As discussed in: Katznelson, Ira. *Fear Itself: the New Deal and the Origins of Our Time*. Liveright Publishing Corporation, 2014.
[liii] Chandler, Alfred D., "Industrial Revolutions and Institutional Arrangements," *Bulletin of the American Academy of Arts and Sciences*, 1980, Vol. 33, No. 8, at 41.
[liv] Noble, David F. *America by Design: Science, Technology, and the Rise of Corporate Capitalism*. Oxford Univ. Press, 1977, at 8.
[lv] Kleinman, Daniel Lee. *Politics on the Endless Frontier: Postwar Research Policy in the United States*. Duke Univ. Press, 1995, at 40.
[lvi] Noble (1977).
[lvii] Bernal, John Desmond. *The Social Function of Science. Reprint*. 1944.
[lviii] *Id.* at 409.
[lix] *Id.* at 127-128.
[lx] *Id.* at 325.
[lxi] Proposal for Science-Industry Partnership presented to the National Association of Manufacturers. April 13th, 1937. 1411, 9, Box 191. 2020.293. NAM Collection, Hagley Library.
[lxii] Minutes, Joint Committee on Scientific Research. September 19th, 1938. 1411, 9, Box 191. 2020.293. NAM Collection, Hagley Library.
[lxiii] Schlesinger (1959) at 180-181.
[lxiv] Brinkley, Alan. *The End of Reform New Deal Liberalism in Recession and War*. Vintage Books, 1996, at 131-135.
[lxv] Hart, David M. *Forged Consensus: Science, Technology, and Economic Policy in the United States, 1921-1953*. Princeton University Press, 1998, at 73.
[lxvi] *Id.* at 69.
[lxvii] *Id.* at 70.
[lxviii] See, e.g., Moyn, Samuel. *Not Enough: Human Rights in an Unequal World*. Belknap Press of Harvard University Press, 2019, 68-89.
[lxix] This subcommittee included William F. Ogburn, an influential sociologist on issues of technological and social change.
[lxx] Summary of Minutes of the Science Committee of the National Resources Planning Board. Box 17, William F. Ogburn papers, University of Chicago Archival Collection.
[lxxi] National Resources Planning Board, *Research - a National Resource: Report of the Science Committee to the National Resources Committee*. 1938, at 2.
[lxxii] "Memorandum for the Briarcliff Meeting" by Charles H. Judd. June 26,1937. Box 18, William F. Ogburn papers, University of Chicago Archival Collection.
[lxxiii] *Id.*
[lxxiv] National Resources Planning Board (1938) at 3.
[lxxv] *Id.* at 9.
[lxxvi] *Id.* at 44-45.
[lxxvii] *Id.* at 28.
[lxxviii] *Id.* at 28.
[lxxix] *Id.* at 14.
[lxxx] *Id.* at 30.

[lxxxi] *Id.* at 33.
[lxxxii] *Id.* at 33.
[lxxxiii] *Id.* at 33.
[lxxxiv] *Id.* at 18.
[lxxxv] *Id.* at 46.
[lxxxvi] *Id.*
[lxxxvii] *Id.*
[lxxxviii] Box 18, William F. Ogburn papers, University of Chicago Archival Collection.
[lxxxix] Hawley, Ellis Wayne. *The New Deal and the Problem of Monopoly, 1934-1938: a Study in Economic Schizophrenia*. 1958; For a more recent review, see Stoller, Matt. *Goliath the 100-Year War between Monopoly Power and Democracy*. Simon and Schuster Paperbacks, 2020.
[xc] Schlesinger (1957) 30.
[xci] *Id.*
[xcii] *Id.* at 31.
[xciii] *Id.* at 21.
[xciv] *Id.* at 32.
[xcv] *Id.* at 419.
[xcvi] *Id.* at 423.
[xcvii] *Id.* at 445.
[xcviii] *Id.*
[xcix] Lind, Michael. *Land of Promise: an Economic History of the United States*. Harper, 2013, at 299.
[c] *Id*. at 300.
[ci] "Message to Congress on Curbing Monopolies." *Message to Congress on Curbing Monopolies. | The American Presidency Project*, 29 Apr. 1938, www.presidency.ucsb.edu/documents/message-congress-curbing-monopolies.
[cii] Phillips-Fein, Kim. *Invisible Hands: the Businessmen's Crusade against the New Deal*. W. W. Norton, 2010, at 5.
[ciii] *Id.* at 13.
[civ] *Id.* at 20.
[cv] Noble (1977) at 10.
[cvi] *Id.* at 12.
[cvii] Reich, Leonard S.. *The Making of American Industrial Research: Science and Business at GE and Bell: 1876-1926*. Cambridge University Press, 1993, at 199.
[cviii] Noble (1977) at 16.
[cix] *Id.* at 88.
[cx] *Id.* at 108-109.
[cxi] *Id.* at 89.
[cxii] Brinkley (1996) at 112.
[cxiii] Noble (1977) at 85.
[cxiv] Arnold, Thurman Wesley. *The Bottlenecks of Business*. Beard Books, 2000, at 173. Reprint.
[cxv] *Id.* at 173-4.
[cxvi] Hamilton, Walton Hale, et al. *Patents and Free Enterprise*. U.S. G.P.O., 1941, at 160.
[cxvii] *Id.* at 162.
[cxviii] *Id.* at 154.
[cxix] *Id. at* 167.

[cxx] Temporary National Economic Committee, *Final Report*. 1941, at 36-37.
[cxxi] Report of the Research Sub-Committee of the NAM Committee on Patents and Trademarks. November 16th, 1938. 1411, 9, Box 191. 2020.293. NAM Collection, Hagley Library.
[cxxii] Minutes of Breakfast Meeting of NAM Patents and Trademarks Committee. December 7, 1939. 1411, Series 11, Box 191. 2020.293. NAM Collection, Hagley Library.
[cxxiii] April 12th, 1940: Minutes of NAM Committee on Patents and Research. NAM Collection, Hagley Library.
[cxxiv] Folk, George E. *Patents and Industrial Progress*. Harper & Brothers, 1942, at 10.
[cxxv] *Id.* at 77.
[cxxvi] *Id.*
[cxxvii] Minutes, NAM Committee on Patents, May 23rd, 1944. Series 9 Box 152. NAM Collection, Hagley Library.
[cxxviii] Special NAM Patents Luncheon, April 30th, 1942. Series 9 Box 151. NAM Collection, Hagley Library.
[cxxix] Minutes of NAM Committee on Patents and Research, April 30th, 1942. Series 9 Box 151. NAM Collection, Hagley Library.

Chapter 2:

New World in the Making: Industry's Battle Over Postwar Science

The entry of the US into a war determined in major part by technological prowess required the federal government to directly promote research to an unprecedented degree. Whereas R&D had largely been, prior to the war, limited to the purview of corporate laboratories, private inventors, and philanthropy-funded university research groups, the federal government emerged by the war's end as the major driver of the national R&D effort. This new role would be permanent: peacetime science programs extended the federal government's R&D support into new domains and set the stage for further expansion of state-backed research in the years to come. By mid-century, these institutional changes had substantially shifted the burden of investment in R&D away from private firms and toward the state. What did American business, and in particular that segment of the business class that would be most directly affected by this institutional revolution––R&D-oriented industrial firms—make of this transition? How did industrial capital position itself in relation to this new state activity?

This chapter examines the response of NAM and its research-oriented committees to the rise of state-driven research during and immediately after WWII. The war prompted a massive expansion of government-backed R&D, the immediate beneficiaries of which were a set of well-established industrial firms, most of which played key roles in determining NAM's positions on patents and research. The sudden rise of public R&D prompted a heated debate over how to organize research policy both during and after the war, which led to the central split between Senator Harley Kilgore, a late New Dealer influenced by both the planning and neo-Brandeisian traditions, and Vannevar Bush, the leading architect of wartime science. Kilgore's proposal for a “proto-industrial policy” led by an “Office of Scientific and Technological Mobilization” prompted major attacks from NAM and forced the organization to formulate its own positions on the proper role of the government in promoting R&D. Ultimately, NAM would endorse a model for postwar innovation policy that closely resembled Bush’s original vision. The institutional conflict that most animated industrial capital’s response, however, was not the debate over centralization and planning, but rather over the ownership of patents resulting from government-sponsored R&D projects. Patents, not planning, primarily determined NAM’s position on the structure of public innovation during this critical period.

This chapter begins with emergence of public R&D on a massive scale during WWII, and details the critical role played by Bush and his elite scientist colleagues in pioneering the new system of state-contractor R&D partnerships. I then discuss the wartime revival of the planning idea and NAM’s calculated moderation toward state-led planning as well as its growing interest in a more coordinated military R&D system. Next, I turn to NAM’s growing concern in the wake of the neo-Brandeisian critique of patents over the government’s wartime patent maneuvers, chiefly the fast-growing set of valuable publicly owned scientific discoveries. This sets the stage for the famous split between Kilgore and Bush. I provide a detailed look at Kilgore’s policy history and R&D planning proposals, and then show that NAM’s attacks on Kilgore’s proposals were primarily motivated by their neo-Brandeisian elements—in particular, their aim to use government ownership of R&D-based patents as an anti-monopoly mechanism. I then detail NAM’s cautious embrace of Bush’s alternative following a series of efforts in the late 1940s to revive the patent-related elements of Kilgore’s vision for postwar R&D. The chapter concludes with the long-delayed establishment of the National Science Foundation in 1950, and NAM’s ultimate acceptance of federal R&D support as a now-permanent feature of the economy—an acceptance based on the continuation of a pro-business patent policy.

The New Science State

It is widely recognized that American wartime industrial production was slow and somewhat chaotic in the initial months following Pearl Harbor. In the domain of scientific research, however, the US was much better prepared, having initiated major projects well before it formally entered the war. A massive scale-up of federal funding combined with a set of new R&D programs and institutions to deliver a vast number of technological achievements. The scale of the newly created science state dwarfed the prewar status quo. Total R&D expenditures (in 1930 dollars) grew from $83.2 million in 1940 to its peak of $1.31 billion in 1945, a more than fifteen-fold increase.[i] Within the DoD alone, the R&D budget increased from $29.6 million to $423 million. The wartime R&D effort involved tens of thousands of individual scientists and poured millions of dollars into the country's leading research universities. By the war's end, MIT alone had participated in 75 research projects to aid the war effort for a total of more than $116 million in contract funding.[ii]

Though the US' capacity to easily out-produce the Axis by 1943 played a critical role in determining the war's outcome, many of these new innovations also bolstered the Allies' battlefield strength and helped seal victory. Achievements in new radar technology, for example, dramatically improved the American military's capacity to sink German U-boats and anticipate aerial attacks. Similarly, the invention of the proximity fuse—a mechanism that set off bombs at a distance from their targets in order to guarantee maximum damage—was a major factor in the success of American bombing campaigns and described by war journalists as "one of the deadliest factors in U.S. mass artillery and anti-aircraft fire." In addition to weaponry, the American R&D

effort also yielded massive success in medical sciences, including a number of new drugs and modernized techniques for treating infections. New methods for mass-producing penicillin made the drug widely available and capable of being deployed to treat battlefront infections. As a result, the American military's death rate from disease decreased from 14.1 per thousands during WWI to 0.6 during WWII.[iii] As historians of the era have long recognized, this was indeed a "scientists' war."[iv]

The crowning scientific achievement of the war, however, was the creation of the atomic bomb. The Manhattan Project was the largest R&D effort in history, accounting for nearly half of the country's wartime science budget. It brought together hundreds of military officials and academic physicists over the course of four years, and birthed a new system of federal laboratories that included Los Alamos, Lawrence Berkeley, Oak Ridge, and Sandia, all of which remain in operation today.[v] The success of the Project, and the eventual use of the bomb against Japan, solidified the central place of science and technology in international power relations, and the emerging great power rivalry between the US and USSR would be defined in major part by scientific competition.[vi] Dubbed by the Truman Administration as the "greatest achievement of organized science in history," the Manhattan Project also secured a new role for elite scientists in influencing the direction of policy.[vii] The technical achievements of the war had raised the public awareness of scientific research and its potential contributions to society, turning an elite cadre of scientists into national figures with the social and political capital necessary to shape domestic affairs.

The most prominent member of this wartime "scientific vanguard" was Vannevar Bush. As an MIT electrical engineering professor in the 1930s, Bush had been personally hostile to Roosevelt, describing New Deal reformism as an "urge for a great bureaucratic organization controlling everything in sight" that had rendered "the creation of truly new industries and products...nearly impossible."[viii] Bush had been a successful spin-off entrepreneur, co-founding the Raytheon Company in the early 1920s with two colleagues, and he bemoaned the new political atmosphere in which "the making of a large profit has been frowned upon."[ix] He often derided New Deal liberals like Tugwell, Berle, and Harry Hopkins as "long-haired idealists" or "do-gooders." His political allegiances were closer to the conservative associationalism of Herbert Hoover, who Bush considered a personal hero. Bush tended to interpret the Depression as a failure of personal initiative and entrepreneurial spirit, and never faulted Hoover for his failure to rectify it.

His contact with the Roosevelt Administration began with a failed bid in 1933 to establish a research partnership between MIT and the Tennessee Valley Authority for a study of electrical transmission that could improve the conductive range of TVA power lines. Bush, along with his MIT mentor Karl Compton, had asked the TVA for $250,000 to fund the study, but the government ultimately pulled out of the project due to a dispute over patent rights that presaged policy debates in which Bush would be involved for the next two decades. TVA chief David Lilienthal wanted the government to retain ownership over any patent rights that might arise out of the study in order to freely distribute them to the public: "After all, the money is of the whole people and, in my judgment, the policy should be that any results should be available to the whole people."[x] But Bush insisted that MIT retain patent rights from the project in order to license the technologies later on, conditioned on a promise to license the use of the patents to the government on favorable terms. Lilienthal and TVA administrators refused to make such a major concession to MIT, which Bush interpreted as incompetence and unwarranted suspicion, and the partnership fell apart.

After this experience had heightened his bias against the New Deal, Bush developed a public reputation as a defender of the foundations of the existing patent system against its neo-Brandeisian critics. Appointed by Compton, Bush briefly headed an investigation as part of the Science Advisory Board into the workings of the patent system in 1935. He concluded in his final report that the system's problems were primarily bureaucratic excess and processing delays, and did not make any findings on the problem of patents and monopoly. His next interaction with the Administration would come years later, when he made his way into Washington's power circles in 1939 as the director of the Carnegie Institution for Science. In his first public appearance upon moving to the capitol, Bush testified before the Temporary National Economic Committee (TNEC) hearings on patent monopolies to try to refute the notion that patent concentration had become an impediment to further innovation. Bush's testimony before the TNEC immediately followed Patent Commissioner Conway Coe, who suggested that the rise of corporate patent hoarding harmed individual inventors and small businesses. Bush countered this narrative by praising the country's corporate laboratories as the new "pioneers" staking out the next technological "frontier"—imagery that he would invoke repeatedly in the coming years. Despite some increased competition with large corporate laboratories, there was no reason that the individual tinkerer could not still make meaningful contributions if the "decidedly democratic" American patent system were allowed to function as intended.[xi]

As the war approached, however, Bush's ambitions overrode his ideological commitments. By mid-1940, Bush had developed plans to create a new military research organization that would contract with academic and industrial research labs for discrete R&D projects to aid war preparations. Bush secured an audience with Roosevelt's inner circle through his personal connection with Federic Delano, FDR's uncle and then-director of the National Resources

Planning Board. Delano had heard Bush's pitch for a new "National Defense Research Committee" (NDRC) and considered the idea "of really great importance" that, in theory, might conform with the NRPB's approach to research planning for the war.[xii] Bush eventually landed an audience with Roosevelt, who greenlit the NDRC immediately.

Bush quickly assembled his team of high-level science administrators, many of whom had established connections to industrial research leadership. This "science vanguard" included Frank Jewett, co-founder of Bell Labs and a prominent advocate for private foundation support for science, and James Conant, the President of Harvard. Bush also brought in Karl Compton, Bush's MIT colleague and the chairman of NAM's Advisory Committee on Patents and Research, a group of outside representatives that sought to influence NAM's strategy. As an active member of this Committee, Compton had worked with NAM to conduct a national survey on industrial expenditures on R&D and to issue recommendations to R&D-oriented firms on ideal levels of research investment. Compton was also a key player in NAM's "Modern Pioneers" program, its public relations campaign aimed at combating the growing suspicion of the patent system articulated by Arnold and the TNEC.[xiii] Compton's involvement with NAM overlapped with his work on the NRDC for one year, until his government commitments overwhelmed his schedule.[xiv]

Mid-1941 saw the dramatic scale-up of Bush's new agency, now renamed the Office of Scientific Research and Development (OSRD). Under Bush's leadership, the OSRD pioneered a method of "federalism by contract" that would transform the federal government's relationship with the scientific community. Though the federal government had contracted with the private sector and universities before, the sheer scale and precision of the OSRD's operation—its capacity to formulate and execute a coherent plan for new innovations in partnership with the nation's most elite research groups—represented a major shift toward state-directed research. For the first time, a federal government agency possessed the technical prowess and command over resources necessary to pick and choose which technological areas would be further developed. The contract system itself also helped the OSRD establish a national network of elite research groups, which Bush and OSRD leadership could tap repeatedly for new projects as the war progressed.

Bush was primarily responsible for the organizational choice to rely on the contract system. During early meetings of the NDRC, Conant suggested that the new agency create its own federally-owned and operated laboratories staffed with government scientists. Bush shot down the suggestion and asserted that the NDRC "will write contracts with universities, research institutes and industrial laboratories." These contracts would be flexible, allowing for the possibility that the R&D project might not be successful: performance of the contract would require only that the contractor "conduct studies and experimental investigations in connection with a given problem and make a final report." In Bush's view, and perhaps influenced by his own experience in trying to partner with the government, the contract system would elevate government R&D work—thought by some to put the researcher in a subservient position—to the status of expert-level consulting. "Contracts are made only between independent bodies or individuals," Bush declared, they "carry responsibility but not subservience."[xv]

Beyond the cost of the research itself, an added incentive for contractors to participate in Bush's new scheme was the hope of obtaining patent rights to inventions arising from their work––an NRDC/OSRD commitment that set the stage for the debate over postwar R&D policy. Initially, OSRD leadership had tried to establish a patent policy that gave the agency flexibility in determining the disposition of patent rights resulting from R&D projects. Before the onset of the war, OSRD contracts with research groups included a patent clause that reserved for the agency "the sole power to determine whether or not a patent application shall be filed, and to determine the disposition of the title to and the rights under any application or patent that may result."[xvi] In determining whether to transfer patent rights to contractors, the OSRD would take into consideration factors such as the importance of the invention for national security and concerns over secrecy. This left the contractor subject entirely to the discretion of the agency. Several potential research partners turned down contracts with the OSRD as a result, fearing that they might be excluded from using their own inventions later on, or even worse, that their competitors would be able to license these patents from the government.[xvii] In early 1941, the OSRD adapted its patent policy in a more pro-contractor direction, following negotiations with a number of prominent OSRD contractors—and NAM Patents and Research Committee members—including General Electric, RCA, Western Electric and Westinghouse Electric.[xviii] The new policy transferred patent rights to contractors but preserved the government's right to use these patents on a royalty-free basis for military purposes.

The OSRD became the most powerful research agency during the war and spearheaded most of the US' technological breakthroughs, including work on the atomic bomb, before primary oversight of the Manhattan Project was passed to the Army Corps of Engineers. At the peak of its activities, the OSRD was spending $3 million per week on over 6,000 researchers in more than 300 industrial and academic research groups.[xix] The agency poured an unprecedented amount of research funding into the country's elite universities, with the number of contracts skewed heavily in favor of a select few, including MIT, Harvard, Caltech, and Princeton.[xx] In some cases, wartime contracts gave rise to new research institutes within universities that would be carried forward for decades. MIT's "Rad Lab," for example, the research program primarily responsible for the US' breakthroughs in radar technology, would remain active after the war and eventually transitioned to the MIT Lincoln Laboratory. While Bush and his science vanguard offered the simple justification that the most capable researchers were based at these universities, they still bore accusations of favoring their home institutions and further widening the gap between leading and lagging schools.

For the nation's leading industrial firms, participation in OSRD contracts brought in millions of dollars in direct research support and generated massive new potential for downstream profits in the form of patent rights. Similar to the pattern OSRD had established with universities, the largest number and highest total dollar value of contracts tended to skew toward a select group of industrial giants, including General Electric, DuPont, Western Electric, RCA, Eastman Kodak, Monsanto, and Standard Oil. These were the very same firms that often occupied leadership positions in NAM's Patents and Research Committee during the same period. Of the top ten principal industrial contractors with OSRD between 1941 and 1945 ranked by dollar value of the contracts, six were members of NAM's Committee.[xxi] NAM's leading R&D-intensive firms were thus major beneficiaries of the new wartime science state, and in particular Bush's generous system of R&D by contract.

Planning for War; Planning for Peace

At the outbreak of WWII in Europe, the US was already the world's leading economic power, with the capacity to outproduce belligerent nations in key wartime industries including warships, planes, tanks, and other weapons.[xxii] Isolationist sympathies, however, driven in large part by memories of WWI, prevented rapid industrial mobilization from commencing before Pearl Harbor. Total mobilization began in January 1942, when Roosevelt announced $50 billion in war spending for the year in order to scale up production of planes and tanks, and to aid in the transformation of civilian manufacturing to wartime production. Many of the country's leading manufacturers converted immediately to military production lines, temporarily abandoning their entire pre-war business strategies and markets. Domestic automakers like Chrysler stopped producing almost entirely for consumer markets and switched to tanks and other battlefield vehicles. The expansion of production from the pre-war baseline to wartime peak output was spectacular. Shipbuilding output multiplied sixty fold; gasoline increased by an order of over one-hundred; and synthetic rubber production, perhaps the greatest technical success story of the mobilization, increased by nearly three-hundred times.[xxiii] By 1944, the US alone was outproducing the Axis by a factor of four.

With the onset of total industrial mobilization, several of the remaining New Dealers in the Roosevelt Administration hoped that the demands of the war economy would resurrect the vision of the state held by the central planners ten years earlier. They also saw an opportunity to restore the reputation of technocratic bureaucracy, now under increased ideological attack from a reemergent conservatism. One prominent New Deal administrator stated in 1941, “With a farewell to normalcy and an appreciation of the greater opportunities that the war crisis presents, public administrators today have an opportunity to enhance and permanently to establish the prestige of their calling in the United States.”[xxiv] FCC chairman Clifford Durr described the situation as many of the remaining New Dealers saw it: “We have learned that we cannot obtain the production we need for waging war as an undirected by-product of what we commonly refer to as ‘sound business principles.’...There must be some over-all source of direction more concerned with these objectives than with the profits or losses of individual business concerns.”[xxv] At the outbreak of the war, Charles Merriam of the NRPB welcomed the arrival of “a new era...a new and finer form of American democratic state, a loftier realm to which human personality may wing its way and find its home.”[xxvi] Total war had suddenly presented a new opening for a planning revival. Alan Brinkley describes the atmosphere as follows:

> ...there was a particular urgency to the calls for planning in the early years of World War II, as if the war itself were a reproach to society for not having heeded such calls earlier. The magazines and journals of the nation's many planning organizations were filled with almost frenzied calls for a national embrace of the planning ideal before it was too late; even more mainstream liberal publications published many such appeals. To some, the belief in planning took on an almost religious quality; the planning faithful, like the religious faithful, tended to assume that those who did not share their views were simply unenlightened.[xxvii]

In practice, however, wartime planning fell short of these hopes. Though war production agencies succeeded in boosting American industrial output to unprecedented levels—all the while maintaining a strict regime of production quotas, price controls, and regulatory mechanisms—it was not widely interpreted as a successful model. As Brinkley has suggested, the war agencies "emerged from four years of effort and achievement with nothing even remotely comparable to the standing and authority of the war boards of World War I had enjoyed at the end of 1918. If they served as models at all, they were models of the perils of state management of the economy, not of its promise."[xxviii] This was largely due to the perceived incompetence and wastefulness of the war effort's leading agency, the War Production Board (WPB). Led by Donald Nelson, a former Sears executive who had served on the Industrial Advisory Board of the National Recovery Administration in 1934, the WPB suffered from poor relations with the military, as other military procurement agencies refused to cede purchasing power to the new Board. Competition between the several bureaucratic bodies charged with coordination further eroded efforts at streamlining mobilization, and Roosevelt eventually had to create a separate Office of War Mobilization (OWM) just to mediate among the contending procurement agencies.

Still, the "Arsenal of Democracy" was an uncontested success. The war mobilization met the needs of the Allies without introducing major scarcity to the domestic economy. It had achieved in less than two years what New Deal reformists had been attempting for the past decade: war mobilization generated full employment for the first time since the 1929 crash, lifting the American economy decisively out of depression. NAM leadership revelled in the new industrial renaissance, pledging to Roosevelt that "Industry will build two battleships for every one that sinks, it will match every enemy bomb with a dozen. It will blacken the skies with planes to replace the ones shot down."[xxix] NAM also saw the war as a major public relations opportunity, hoping to counter the anti-business narrative promoted by the neo-Brandeisians and remaining New Dealers within the Administration. As part of this campaign, NAM produced a series of nationally-televised film shorts entitled *Defense for America*, pitched with slogans such as "Can America Out-Perform Dictators?" and "Free Men Versus Regimented Slaves."[xxx] NAM leadership believed this effort had paid off by 1943, when the organization's public relations chief noted that the "political climate towards industry has changed so that the type of attack which flourished in the thirties is not particularly feared."[xxxi]

The massive influx of government-backed demand revived consumer markets and launched the economy into the "Golden Age" of postwar capitalism. As a result, a new liberal institutional order quickly emerged that would come to dominate American politics for the next thirty years. This was the Keynesian consensus, in which the government would engage in counter-cyclical management of the economy through public spending to boost effective demand. New Dealers still embraced the rhetoric of planning and the ultimate goal of a "planned economy," but their emphasis had shifted from supply-side and production-oriented planning to demand-focused planning that sought to nurture the burgeoning consumer market. "Concentration and control" had been transformed to "planning for full employment," a less ambitious commitment that Brinkley characterized as aiming to "manage the economy without managing the institutions of the economy."[xxxii] As the remaining institutional voice for planning within the Administration, the

NRPB shifted its emphasis to macroeconomic management and social welfare, releasing its report *Security, Work, and Relief Policies* that envisioned a full employment, high-consumption economy after the war.

While industrial business leadership had been a cautious partner in the economic planning experiments of the First New Deal, it would quickly become an avid promoter of this new, more conservative version of planning. As the war mobilization advanced and its benefits became increasingly apparent, the business community began to embrace the new "planning" vision of a robust government presence in the economy through spending and basic regulation. As Charlie Whitham has demonstrated, the war economy prompted the rise of the "post-war business planners," a powerful network of business leaders and liberal policy figures that would develop the "corporate liberal" consensus of the postwar period. Business organizations such as the newly formed Committee for Economic Development (CED), Twentieth Century Fund (TCF), and National Planning Association (NPA) became leading promoters of postwar "business planning" that emphasized macroeconomic management to sustain high demand and consumption. Many of the individuals responsible for driving the ideological mission of these organizations were New Dealers who had served in the Roosevelt Administration, including Adolf Berle (TCF) and Alvin Hansen (NPA).[xxxiii]

Focusing primarily on higher-level proposals for more assertive federal spending and economic regulation, these groups largely abstained from the kind of detailed policy lobbying and advocacy carried out by NAM. The postwar business planning organizations did, however, shift the overall political framework in which NAM operated and forced it to accept some of the basic assumptions of the new corporate liberal consensus: a permanent role for the government as guarantor of demand, some degree of regulatory intrusion into business operations, and some efforts to redress the market's inequities through compensatory tax-and-transfer schemes. NAM leadership created a new Postwar Planning Committee, which debated many of the ideas being promoted by the CED, TCF, and NPA. While never fully adopting the Keynesian platform during this period, NAM began to cooperate more with the business planning organizations, attending conferences with the CED and offering up the NAM's own vision for economic security after the war. As Delton has shown, NAM had begun during the war to make "key concessions to the liberal state," testifying in favor of federal legislation for economic stabilization and regularly hosting meetings with prominent liberals like Henry Wallace.[xxxiv] By the war's end, NAM would put forward what the popular press deemed "the liberal platform," which included a more moderate position on unionization, support for international economic cooperation, measures to promote full employment, higher wages for public workers, and greater benefits for veterans. Walter Weisenberger, the moderate executive director, heralded the arrival of "a new NAM," one that "aimed right down the middle of the road" toward a vision of "constructive liberalism."[xxxv]

As part of this reconciliation with the wartime state and its achievements, NAM's R&D-focused committees demonstrated a newfound appreciation for government-sponsored research. At one conference hosted by the Patents and Research Committee after the war had ended, various representatives from the major players on the Committee took stock of the wartime R&D experience. Bruce Brown, the Committee representative from Standard Oil, gave a talk entitled "Research, Industry, and Government," in which he noted that "Wartime applied research paid for by government struck into many fields formerly left for private competitive development."[xxxvi] Brown concluded that "war production produced amazing results," and looked forward to a postwar reality in which "Federal funds wisely administered...would contribute to our national well-being." Earlier, the Committee issued several press releases during the war indicating that the

Committee had begun to look toward a postwar future of high consumption and full employment, and that military-based research would play some role in sustaining that future. According to a timeline of NAM publications, one press release suggested that the war had demonstrated that "jobs, incomes, and more, better and cheaper goods and services for the post war years will depend to a large extent upon scientific research." Shortly thereafter, NAM issued a booklet entitled "Patents and Your Tomorrow," which sought to make the case that "the new world which is in the making will depend upon the progress of science and invention."[xxxvii]

NAM had not only shown its recognition of the critical role of government-backed R&D during the war, it had even taken some steps to lobby for a more robust and coordinated wartime R&D system. In early 1942, the Patents and Research Committee held one of its meetings with Maury Maverick, a prominent War Production Board administrator, as an invited guest. During this meeting, the Committee discussed with Maverick possibilities for "a plan for expansion of industrial activities under the direction of the War Production Board" and the "need for better mobilization of the nation's research facilities for war and for civilian necessities." Maverick then invited representatives from the Patents and Research Committee to a meeting in Washington in which the problem of how to organize research for the war would be further explored.[xxxviii] The link with Maverick is significant, as he was a leading figure within the WPB trying to push the Board in the direction of planning along New Deal lines. During his two-term stint in Congress in the 1930s, Maverick was a major proponent of state-led development planning, advocating for increased use of the TVA model in other parts of the country. He had been appointed to the WPB to represent the interests of state and local governments, but he quickly began developing ideas for a centralized R&D planning agency within the Board. That NAM would seek cooperation with

Maverick, a well-known proponent of New Deal-style planning, suggests the organization was not opposed to the R&D planning at this early stage of the war.[xxxix]

Maverick formed a committee within the WPB to investigate the possibility and held hearings with the WPB's Planning Committee. Ultimately, he called for the creation of a WPB-based Office of Technological Development (OTD) funded at up to $100 million. The OTD would engulf all of the R&D efforts that were then underway under the auspices of the WPB. Though Maverick's proposal did earn endorsements from some members of Roosevelt's inner circle and the popular press, WPB leadership initially rejected the idea. When WPB chief Donald Nelson finally created an R&D sub-agency within the Board called the Office of Production Research and Development (OPRD), it was given far less autonomy and a modest budget of $5 million—only 2% of Bush's OSRD budget. The OPRD did not emerge as a major coordinator of wartime R&D, as Maverick had intended. It did, however, serve as one of the inspirations for a series of new legislative proposals from Harley Kilgore, a New Deal-allied Senator from West Virginia.[xl] Similar to Maverick's OTD, Kilgore advocated for a central wartime R&D planning agency that could coordinate the various research efforts that were emerging. Though it had demonstrated some interest in such an agency in its interactions with Maverick in early 1942, NAM would later lead the opposition to Kilgore's proposals and sink his efforts to establish state-led R&D along New Deal lines. The reason for NAM's shift was a newly emerging threat that the war economy had introduced, one for which NAM would make no ideological accommodation.

Patent Leviathan

While the war economy represented a sharp break with prewar political economy vis-a-vis state coordination of production, it also initiated a dramatic increase in public ownership. Unlike WWI, in which the federal government financed only 10 percent of total war plant, the WWII mobilization effort was overwhelmingly government-funded, with public capital accounting for two-thirds of new plant and equipment.[xli] From the beginning of the production drive until the war's end, the US relied primarily on a joint partnership model in which production plants were owned by the federal government but managed and operated by private contractors. This "government-owned, contractor-operated" (GOCO) scheme constituted by far the largest share of new wartime investments in manufacturing, and they were critical to nearly every war-related sector. While a select few industries with large prewar markets—steel products and automobiles, for example—could rely on already-constructed private factories, wartime products like synthetic rubber, bombs, and combat ships were scaled up almost entirely with publicly owned factories.[xlii] With smaller firms lacking capacity to operate plants of such massive scale, the government turned to the usual patrons: Union Carbide, DuPont, Eastman Kodak, General Motors, and others.

By the war's end, the federal government had become by far the largest owner of industrial capital across the economy. In 1945, the government owned the majority share of manufacturing capacity in the aircraft, shipbuilding, aluminum, and synthetic rubber industries. In total, about a quarter of the value of the nation's manufacturing assets was state-owned, the largest set of such assets outside the Soviet Union.[xliii] It is no surprise, then, that the spectre of public ownership began to haunt national business leadership and conservative political allies. Even before full-scale mobilization began, a Chamber of Commerce publication identified government-owned plant as the "ghost that stalks at every business conference" and "the object of fear and misgiving."[xliv] Politically active manufacturing executives warned that the country appeared to be sliding toward "governmental socialization of private industry," and an overwhelming majority of business executives responded affirmatively to a *Fortune* magazine poll asking whether the Roosevelt Administration was "using the national emergency as a pretext for pushing still further the more radical social and economic aims of the New Deal."[xlv] At NAM's annual meeting in 1943, General Motors chairman Alfred P. Sloan Jr. warned NAM member firms that government-owned enterprises could become a permanent feature of the new American economy after the war. The GOCO system had demonstrated on an unprecedented scale that a large portion of the industrial economy could be publicly owned, and that if this were to continue into peacetime it would be "the beginning of the socialization of enterprise."[xlvi]

For NAM and other business groups, the scale of the GOCO system prompted fears of a massive postwar state-owned sector that might compete directly with private industry. In an exchange between NAM president Federick Crawford and Sloan, the two businessmen agreed that the prospect of government ownership and competition with private industry was the greatest threat to business interests—much more so than the usual worries over taxes, labor relations, and regulation.[xlvii] NAM-allied senator Robert Taft predicted during the war that "Many of the new industrial plants will be owned by the government. Whether they will ever be returned to private industry, any more than [the Tennessee Valley Authority] was returned to private industry, may well be doubted, unless Congress is constantly on guard, and determined to restore a system of privately owned and operated enterprise."[xlviii] Taft was responding to a growing call from the remaining New Deal planners to use the GOCO plants for TVA-style state-led development. Before its budget was eliminated in 1943, the NRPB issued a series of proposals for converting many of the government-owned war facilities into permanent government corporations that could absorb excess labor in order to serve the goal of a full-employment economy. Members of Roosevelt's cabinet also saw opportunity in the GOCO system. Harold Ickes, Interior Secretary and one of the very few remaining liberals in the Administration from the First New Deal, wanted the GOCO plants to be operated as public corporations with shares issued to veterans following the war's conclusion. Public opinion polls at the time suggested that these ideas were broadly popular, putting business leadership further on the defensive.[xlix]

NAM and other business groups' fears were overblown, however. In 1944, already anticipating the demobilization effort, the Roosevelt Administration created the Surplus War Property Administration (SWPA), an agency tasked with converting GOCO plants and unused war equipment into civilian use. Though many New Dealers had hoped Roosevelt would appoint the TVA's David Lilienthal to steer the agency, business pressure pushed the Administration to name Will L. Clayton, a much more business-friendly option.[l] What followed was the largest privatization of government property in American history. Over the next ten years, the SWPA and its progeny liquidated nearly all excess war equipment—primarily through conversion into scrap metal—and sold off its GOCO plants to private industry. Many of the individual plant sales resulted in spectacular losses for the government, with the average selling price only 36 percent of the original cost of the plants. The massive $200 million steel plant in Geneva, Utah, for example––the largest GOCO plant outside of the Manhattan Project—was sold to U.S. Steel for only $47 million.[li] This reflected a broader trend in the wave of privatizations: since only the nation's largest industrial firms could make use of plants of this scale, these were the firms that benefited overwhelmingly from the selloff.[lii]

Before their reconversion victory, however, industrial firms remained on high alert for any forms of wartime state ownership that might present opportunities for progressives to revive New Deal goals. Emerging in parallel to its concern over state-owned physical capital, NAM leadership turned its attention to growing incursions by the federal government into the private patent system. The TNEC's investigations had only just concluded, and Thurman Arnold was still leading his anti-monopoly crusade as DOJ Antitrust chief; the "radical attack" on patents that NAM had worried about appeared to be gaining some new steam during the war. In early 1942, the Senate Committee on Patents, headed by prominent New Dealer and anti-monopolist Homer T. Bone, put forward S.2303, a bill that would have allowed the President to compel licensing of any privately-held patent deemed important for the war effort. Compulsory licensing would be compensated at only a "reasonable royalty" to be determined by the Executive.[liii] The powers granted to the President under this bill would not be limited to the current war, and would any period of national emergency declared in the future. Roosevelt had issued a letter of support to Senator Bone, thanking his Committee for investigating the problem and acknowledging that "Patents are the keys to our technology; technology is the key to production; production is the key to victory."[liv]

Bone opened the hearing by asserting that the onset of war demanded "the mobilization of our every resource" including "every form of property right under the American flag." He described the wartime patent system as an exception to its normal course: "The American patent system enters the trenches and goes along on the battlefield with our boys." However, Bone also indicated his intent to use the wartime exception to probe abuses to the system in the form of "contractual and cartel arrangements" of patent concentration that have functioned "to the detriment of our country."[lv] Other Senators invoked the findings of the TNEC on patents and made explicit reference to the TNEC monograph *Patents and Free Enterprise*, excerpts from which were entered into the hearing record.[lvi] In his testimony in support of the measure, Senator La Follette, a longtime New Deal ally, ratcheted up the populist rhetoric, warning that patent hoarding by "totalitarian corporate empires at home" would slow the war mobilization. But the most in-depth testimony came from Thurman Arnold, still active as the crusading Assistant Attorney General.[lvii] Arnold summarized his entire trust-busting philosophy to dealing with patent abuses, and extolled S.2303 as necessary both for scaling up wartime production and for permanently eroding the power of patent cartels in the future. Even if the federal government were able to reign in patent abuses during the war, Arnold suggested, big business "will again start up similar patent cartels and try to do the same thing all over again."[lviii] Arnold therefore urged the committee to take full advantage of the wartime exception to pursue a permanent fix to many of the problems of patent abuses.

NAM's internal deliberations over S.2303 suggest it was highly troubled by the proposal. The Patents and Research Committee resolved that it was opposed to the bill, "both as to form and substance." Though the Committee did acknowledge that during the war "patent rights should unquestionably be subject to requisition by the government" if they serve a critical purpose, it disapproved of S.2303 due to the proposed level of compensation. While the bill prescribed only a "reasonable royalty" to private patent owners for their wartime use, the Committee felt that compulsory licensing constituted a full taking of property under the Fifth Amendment and as such, required "just compensation" at a higher level. NAM had attempted to appear before the Senate Patents Committee to testify on the bill, and had written to Senator Bone requesting to do so, evidently without success. The Patents and Research Committee found Arnold's appearance particularly troubling, and the NAM advisor George Folk found in Arnold's testimony a "strong inference that patents are not property and hence may be condemned by the government without provision for just compensation to the patent owner."[lix] The bill and its accompanying testimony was thus viewed as an extension of pre-war attacks on the patent system by the neo-Brandeisian revival.

NAM also saw S.2303 as a harbinger of things to come. In May of 1942, the Patents and Research Committee issued a series of recommendations to the broader Association regarding wartime patent incursions by the government. These included a call for NAM to "in particular express its opposition to any proposals which involve the proposition that patents are not property rights subject to the same Constitutional protection as all other forms of property," and that wartime patent reforms not be extended into the postwar period. "[A]ny legislation now to be considered," NAM urged, "should be confined to the use of patented inventions for purposes of national defense and the prosecution of the war to cover any gaps in the present law.[lx]" Gearing up for future conflicts over wartime patent provisions, the Patents and Research Committee issued a directive to all R&D-oriented members "to take personal responsibility in advancing industry's point of view on the patent system and pending legislation." Toward that end, the Committee recommended lobbying measures and becoming more involved with public relations campaigns on the value of the patent system.

An additional cause of NAM's concern was the rapidly expanding inventory of state-owned patents resulting from wartime R&D projects. Though the default position of Vannevar Bush's OSRD was to transfer ownership rights of inventions to the industrial contractors that carried out projects, an increasing number of technological breakthroughs were deemed of such high public value that state ownership was seen as obviously warranted. In the field of radar, for example, advances made at MIT's Radiation Laboratory and Harvard's Radio Research Laboratory were placed under government ownership and control. The unusually high number of inventions made in these labs led to the creation of the Government Radar Patent Program (GRPP), a separate office staffed with government lawyers responsible for prosecuting and protecting radar-related intellectual property. On an even larger scale, the OSRD's early experience in handling what eventually became the Manhattan Project prompted a rethink of the pro-contractor policy. Following an update from Bush on the early successes of the project, Roosevelt himself directed the OSRD and all other agencies involved to retain, to the extent possible, full legal title to all inventions and discoveries made during the course of the project. In his official history of the

OSRD, Irvin Stewart noted that though the OSRD's patent policies were often highly favorable to contractors, the growing number of exceptions placed "in the hands of the Government substantial rights under many developments, some of them of great peacetime significance."[lxi]

In the same way that the GOCO system prompted fears of state-owned industry out-competing the private sector, the growing threat of public patent ownership was not lost on NAM's leading industrial contractors. By mid-1942, a major point of conversation in meetings of the Patents and Research Committee was the fate of patent rights resulting from wartime R&D contracts. Advisor George Folk noted during one meeting that the topic "was of great importance" and that a "strong tendency for the government to obtain a great number of patents by means of these contracts" could now be observed. Unless NAM could do something to buck this trend, Folk suggested, "there is great danger of the government going into the patent business."[lxii] The topic arose again in a meeting several months later with an administrator from the War Production Board responsible for crafting the Board's patent policies. Acknowledging that government acquisition of patent rights from R&D contracts had become increasingly common, the Committee urged all its members to exercise care in negotiating contracts with agencies like the OSRD so as to prevent further accelerating this trend. Failure to do so, it was noted, "may put the government in competition with private industry in the post-war period," echoing the language voiced in opposition to GOCO reconversion.

In the early months of the war, then, NAM's views toward the new science state were marked by ambivalence. Mirroring its pragmatic approach to New Deal planning discussed in the previous chapter, NAM firms acknowledged the massive benefits that the emerging federal stewardship of wartime R&D could deliver. The Patents and Research Committee had even made an initial showing of support for a more centralized and planned R&D program, agreeing to meet with Maury Maverick during his campaign for an Office of Technological Development with wide-ranging powers to coordinate research. The same industrial firms were, however, highly critical of the emerging shift toward wartime state ownership embodied in the GOCO system, and anticipated a similar trend developing in the domain of intellectual property. The government had demonstrated beyond a doubt that it could effectively stimulate rapid advances in research, and NAM envisioned a potentially massive set of intellectual assets that the government could use to crowd out private initiative. NAM's fears would be realized by the midpoint of the war, when Harley Kilgore, a freshman senator from West Virginia, entered the policy debate over wartime science.

The Social Frontier

Kilgore was new to electoral politics, having been hand-picked by the West Virginia Democratic machine to defeat an incumbent who had turned against Roosevelt on critical policy issues in the late 1930s. Kilgore was seen as a loyal New Dealer who would help bolster Roosevelt's mandate, now waning with loss of the Southern Democrats and the emerging revival of conservatism nationwide. Upon moving to Washington in early 1941, Kilgore quickly became a very active senator, leading and participating in a number of investigatory committees. Though not as ideologically committed to the planning idea as many earlier New Dealers, Kilgore did evince a preference for centralization and coordination. After Pearl Harbor, Kilgore turned his attention toward military matters and was dismayed by the inefficiencies he perceived in the early war mobilization. He prodded Roosevelt to establish an Office of War Mobilization, a new agency that would centralize war production and avoid what Kilgore saw as an excess of duplication and overlapping in the emerging effort.[lxiii] The effort was unsuccessful—Roosevelt preferred a flexible style of delegation to multiple competing agencies—but it established Kilgore as a leading senatorial proponent of wartime planning.

Kilgore first became aware of the complex set of R&D programs linked to the war that were already in operation—including Bush's OSRD—during hearings before the Senator Military Affairs Committee in early 1942. He was confused by the fragmented and seemingly redundant organizational structure of the wartime R&D effort, and asked during one hearing, "through this labyrinthine maze, how do you expect the man who may have an invention to bring in here to wander his way through it?"[lxiv] The situation was all the more grave, Kilgore believed, since victory would now depend on science and research much more so than previous wars. However, Kilgore quickly understood that a more effective national mobilization of R&D would not only aid the war effort, but would be a major driver of postwar prosperity as well. In a speech given a few months after his committee meetings on military R&D, Kilgore noted this connection:

> War is a most unfortunate thing: it is destructive, both of life and property, but, like all black clouds, it has a little silver lining. It is also a cause for accomplishment, usually in the field of science...this war already has produced mechanical inventions not even dreamed of before its outbreak — mechanical inventions that will make for a large, a fuller life, if given proper expansion and their place in a peaceful life. Now, most of these inventions are used to take life, or to make it more unbearable. Great portions then can be just as easily turned to make for a fuller and happier life when peace has become an accomplished fact.[lxv]

This observation reflected a common theme in Kilgore's approach to military preparations: that the organizational structure of the war mobilization would carry significant consequences for the postwar economy. Like many of the Administration's leading liberals, Kilgore was convinced that a mishandled reconversion effort at the conclusion of the war would trigger a return to Depression-era conditions. He predicted that demobilization would spike joblessness, potentially at the level of 20 million unemployed workers. His simultaneous involvement in both the wartime buildup and in reconversion planning as early as mid-1943 reflected this concern. Kilgore's approach to reconversion relied on a central planning capacity that would, in theory, avoid a rapid termination of wartime contracts and selloff of public assets that could trigger unemployment. In a statement prepared on the subject, Kilgore warned of a "gamble with economic disorganization" following the war's conclusion and urged "comprehensive legislation" that could encourage a "cooperative effort of industry, agriculture, labor and government to maintain full production and employment...into the period of reconversion and peace."[lxvi] To this end, he put forward legislation proposing a new agency, an "Office of War Mobilization and Adjustment"—a revival of his earlier proposal, but with added powers to plan for the postwar conversion of war resources and jobs. Though it ultimately lost out to more conservative approaches to reconversion, which allowed for Kilgore's fears over a GOCO selloff to be realized, the proposal reflected Kilgore's growing enthusiasm for planning.

Kilgore's primary influence on the matter of R&D planning, however, appears to have been Herbert Schimmel, a medical researcher who had worked in the late 1930s on a series of studies conducted by the Works Progress Administration on industrial research and its role in the national economy. Initiated by chief Roosevelt aid Harry Hopkins, these WPA studies analyzed the ways in which research and technological change were potentially creating new opportunities for employment. In the late 1930s, in the same period in which the National Resources Planning Board began to focus on R&D as a potential target for national planning, the NRPB assumed oversight over the WPA studies on industrial research. In one of the reports to which Schimmel contributed focusing on the rise of industrial R&D and its concentration among large firms, the introductory matter notes that "Government-sponsored research has been generally recognized as an important factor in the development of science and technology. In agriculture, mining, aviation, and many other spheres of endeavor Government scientists have performed outstanding work." Hinting at the potential for a scaling up of state-backed, R&D, the report asserts that "Further extension of Government research...suggests itself not only as a source of employment for our trained but unused scientific personnel but also as a means of furnishing much needed information to enterprises which could not otherwise afford to obtain it."[lxvii]

Schimmel became Kilgore's chief legislative aid in the summer of 1942, and it is likely that he pushed the Senator to embrace the approach to government-backed R&D along the lines of New Deal central planning. A self-described "radical," Schimmel would later describe his work as a researcher for the WPA as the "highlight of his professional life."[lxviii] It is noteworthy that the opponents of Kilgore's R&D planning proposals, including NAM, consistently described Schimmel as a greater threat than the Senator himself and the one likely to have promoted the most troubling features of these proposals. NAM later accused him of harboring communist sympathies: in 1953, several years after Schimmel and Kilgore's collaboration had ended, the NAM Patents and Research Committee was still discussing Schimmel, identified as an "active staff member and propagandist" for Kilgore's proposals who sought to develop R&D "central planning on a scale strikingly similar to a totalitarian Government." According to NAM, Schimmel's influence over Kilgore in the mid-1940s was further evidence that "radicalism in Washington [had] not been a phantom."[lxix]

Though he demonstrated serious interest in planning during his early months as a senator, Kilgore was establishing a more prominent role for himself as one of the Senate's leading anti-monopolists. Kilgore's neo-Brandeisian impulses were rooted in personal experience: as a child, he had witnessed his father, an owner of a small oil refinery company, driven out of business by Standard Oil.[lxx] Kilgore found a new target in the early months of the war mobilization, which he instinctively recognized as an opportunity for industry giants to further consolidate their market power. Though the war economy did provide ample benefits to small and medium sized manufacturing firms, which often worked as subcontractors for large orders, the largest contracts went to the national leaders. To achieve the synthetic rubber miracle, for example, the federal government turned to "big rubber" (Goodyear and B. F. Goodrich), "big oil" (Standard Oil of New Jersey), and "big chemical" (DuPont and Union Carbide).[lxxi] Kilgore lamented this situation, which he interpreted as a massive windfall to already-established firms and a major blow to small and medium-sized enterprises. His suspicions were compounded by the increased presence in Washington of "dollar-a-year men," executives from major corporations who had flocked to Washington to occupy wartime administrative posts. Kilgore was determined to avoid a repeat of WWI mobilization, widely seen as an unprecedented giveaway to America's corporate leadership.

Kilgore's anti-monopoly affinities landed him a spot in late 1941 on Senator Harry Truman's Special Committee to Investigate the National Defense Program, the leading congressional group to study corporate abuses and planning efficiencies in the war program. Truman had been impressed during a personal meeting by Kilgore's interest in wartime corporate graft, and believed his energetic approach to Senatorial investigations would be a valuable addition to his Committee. Kilgore led a series of sub-investigations for the Committee, exposing several instances of abuse by large corporations involved in the war effort, including Standard Oil.[lxxii] His work on the Truman Committee also raised his awareness of the growing threat of international business cartels that Kilgore believed had directly hampered American war preparedness and aided the Axis instead. Kilgore believed that prominent American industrial firms like DuPont had colluded with German firms like I.G. Farben to divide up world markets. This had served as a major boon for Germany industry, allowing for a faster remobilization. According to Kilgore, this type of behavior had “strengthened the hand of the German cartelist, who weakened us by agreements with American cartel members while they strengthened Germany.”[lxxiii]

Kilgore saw intellectual property as a critical component of these illicit practices. Though he saw excessive concentration of patents as an impediment to war preparations in general, Kilgore viewed patent-oriented cartel arrangements between US-based and foreign firms as particularly egregious. In some cases, American industrial firms had agreed to license patents to German competitors on a conditional agreement not to compete in certain foreign markets. This had resulted in German firms gaining key technical capacities in the leadup to the war. The reverse situation had also occurred, which Kilgore described as follows:

> Certain American industrialists were content to relinquish large portions of the world market in order to monopolize the domestic market through exclusive access to German-originated patents. As a part of these arrangements, the Germans craftily imposed upon the American companies terms which provided them with vital military information at the same time that they imparied our production of war goods.[lxxiv]

Ultimately, Kilgore’s anti-monopoly instincts led him to the view that large corporations could not be trusted to make use of the patent privilege for the benefit of the national economy. While some major firms used patent rights as the basis for collusion with foreign enemies, others simply abused patents to thwart wartime production and technological development. “Monopolistic repression of new development,” Kilgore observed, “was one of the factors in the industry’s technological old age.”[lxxv] These tendencies, along with Schimmel’s enthusiasm for planning applied to science, are likely what led to the institutional choices set forth in Kilgore’s initial proposals for a centralized R&D agency.

The first of these proposals, S. 2721, had been developed over the summer of 1942, not long after Schimmel joined Kilgore’s staff. The idea for a congressionally-supported “Office of

Technological Mobilization" first came from Schimmel, though Kilgore had been enthusiastic about it from the start. It was Schimmel's view that the efforts led by Maury Maverick and others to establish a separate R&D office within the War Production Board were under-ambitious: a WPB-based office "could accomplish very little," Schimmel claimed in a memo to Kilgore, "as there it would be circumscribed by the same factors" that had slowed down the initial mobilization effort.[lxxvi] The "real solution" was therefore "an independent office" separate from the WPB that could exert more authority. Just three days after Kilgore received this memo from Schimmel, his office introduced S. 2721, "The Technology Mobilization Act." The quick turnaround reflected Schimmel and Kilgore's desire to head off alternative proposals that were emerging from within the WPB.

Under the proposed bill, a new "Office of Technological Mobilization" (OTM) would subsume the existing wartime R&D efforts and would have broad powers to influence the direction of the research. These included control over all R&D grants issued by the federal government during mobilization, which gave the office the capacity to develop an overall technological strategy for the war by choosing which areas to direct its support. The OTM would also have the power to construct public manufacturing plants and laboratories, and to draft engineering and scientific personnel on particular projects. The office would also be able to license already-existing patents in service of the war effort, and all patents resulting from the OTM's work would be placed under the control of the office for direct use or licensing. The listed purposes of the bill included "the full and immediate utilization of the most effective scientific techniques" by mobilizing "all technical facilities, equipment processes, inventions, and knowledge." The OTM would use its new powers to "[break] the bottlenecks that today choke up these technical forces and result in the diversion of vast amounts of material, time, and effort...by making fully available all patents and all applied technical knowledge for full war use." The OTM would not reside within an existing wartime agency; rather, it would be an independent office reporting directly to the President and to Congress.[lxxvii]

Hearings on the Technology Mobilization Act were held under the auspices of the Committee on Military Affairs over the course of several days in October. The hearings included testimony from fifty-five witnesses, the result of weeks of effort by Kilgore and Schimmel to solicit support for the bill from political allies. Kilgore's statements during these hearings, as well as statements from witnesses themselves, emphasized the centralizing and coordination-oriented impulse behind the bill. Kilgore noted that "the research policy of the United States Government has been utterly chaotic ever since we founded the Republic," and the centralizing function performed by the OTM would help "get back to a sensible foundation."[lxxviii] Lyman Chalkley, an administrator from the Federal Board of Economic Warfare, lauded the bill's effort to introduce overall coordination into wartime R&D, and noted positively that similar efforts to do so in Britain had been successful. Kilgore argued that the war effort was currently making use of over twenty different agencies dealing with technological development, and the resulting inefficiencies and redundancies of this setup were that only one-third of the country's scientific resources were being utilized. The new OTM would provide "over-all" direction to the R&D effort and aim to "coordinate and integrate the activities of all governmental and private technological agencies."[lxxix] The result, Kilgore suggested, would be "the prevention of duplication" and the "acceleration of the scientific war effort."

The hearings also demonstrate that concerns about patent hoarding and bottlenecks slowing the pace of wartime technological advances were a leading motivation for the bill. In his opening statement, Kilgore explicitly noted his observations of patent abuses and cartels during investigations with the Truman Committee. He also voiced his objection on grounds of fairness to the practice of private ownership of patents derived from publicly funded R&D. In an exchange with Donald Nelson, chief of the War Production Board and supporter of Kilgore's proposal, Kilgore pointed out that new wartime inventions had been developed "at the expense of the Government" and as such should not be turned into "private monopolies."[lxxx] Kilgore commented further:

> That question was asked me by a man who had developed some new things in his plants which was on a [government-funded] basis. He said, "I wondered if I should patent these things in my own name." He said, "I don't think I should because these things belong to the United States. They paid for them. I just had the germ of an idea in here, and they made it work." I can see the tremendous problems in that direction in post-war reconstruction.[lxxxi]

Nelson shared Kilgore's attitude and suggested that government-financed patents should be placed into the public domain rather than granted as a windfall to major corporations. Department of Justice lawyer Robert Hunter also appeared before the Committee to discuss the importance of the bill's patent policies. With Kilgore's backing, Hunter recounted the patent abuses involved in international cartels and discussed the I.G. Farben case at length. He described the proposal as "a piece of vitally needed legislation," and suggested that government control over publicly funded patents would be a fitting mechanism for combatting the kinds of abuses Kilgore had highlighted.[lxxxii]

S. 2721 generated a significant degree of support from within the Democratic ranks and received some positive press coverage, but Kilgore encountered a setback when the party suffered major losses in the 1942 November election. The bill died in committee, and Kilgore used the following months to continue tweaking his idea. During this time, Schimmel began urging the senator to think longer-term by recasting the bill as both a wartime and postwar reform.[lxxxiii]

Meanwhile, S. 2721 had sparked further interest among policy circles in the issue of federally planned of R&D. Waldemar Kaempffert, a science reporter and member of the New York Times Editorial Board, published an article in the *American Mercury* entitled "The Case for Planned Research," in which he praised Kilgore's approach as an attempt to "bring order out of chaos."[lxxxiv] Kaempffert had earlier appeared during the S. 2721 hearings and focused on the benefits that centralization and coordination could bring to the government's R&D efforts. Under the current system, he argued before the Committee, "there has been no concentrated social purpose in planning, no direction, no organization, except since this war."[lxxxv] "*Laissez-faire* has been abandoned as an economic principle," Kaempffert suggested in his article, "it should also be abandoned, at least as a matter of government policy in science."[lxxxvi]

Kilgore's next proposal, put forward in March of 1943, was far more ambitious than his first, and reflected several months of further refinement by Schimmel and the Senator's staff. Much like S. 2721, the "Science Mobilization Act" (S. 702), would establish a centralized agency with broad powers to coordinate federal R&D in accordance with a national technology development plan. Like the OTM, this new "Office of Scientific and Technical Mobilization" (OSTM) would be an independent office with control over the entire array of federal R&D efforts. The OSTM would also make assessments of the current level of utilization of existing technology and develop policies in accordance with national R&D priorities. Importantly, the OSTM's patent policies would be structured along similar lines to the initial proposal, with the default policy being government ownership and control over patent rights resulting from OSTM projects.

Unlike Kilgore's first proposal, however, the OSTM's role would extend well beyond the war economy. The OSTM's mandate included not just maximizing the utilization of research for the war effort but also promoting technological development for "peacetime progress and prosperity."[lxxxvii] Kilgore's targets had clearly broadened beyond immediate military needs and, reflecting his interest in the revival of planning in service of reconversion, now included long-term economic growth and full employment. It is clear from the bill's stated justifications that Kilgore's conviction that the nation required a more coordinated R&D system in order to accomplish these goals had deepened. The OSTM was to rectify "the unassembled and uncoordinated state of information concerning existing scientific and technical resources"; "the unplanned and improvident training, development, and use of...resources and facilities in relation to the national need"; and "the absence of an effective Federal organization to promote and coordinate, in the national interest, scientific and technical developments." The proposed composition of the OSTM's reflected the bill's aim to generate an R&D policy in the "national economic interest," with representation from scientific organizations, industry, agriculture, and labor. Daniel Kleinman has thus characterized S. 702 as a proposal for a "proto-industrial policy" agency that would have installed the kind of centralized industrial policy capacity later developed in other rapidly developing countries in the postwar era.[lxxxviii]

The bill also contained a more developed patent policy than that described in the first proposal. Section 7 of the bill, entitled "Protection of the Public Interests in Discoveries and Developments Financed by the United States," specified that exclusive rights to use and license all patents resulting from government-backed research would vest in the OSTM alone.[lxxxix] Licenses granted to private firms would be non-exclusive, allowing the government to retain its stake in the patents. Use rights to any patents resulting from OSTM projects would therefore be open to the public. If firms wanted to use OSTM patents for commercialization, they were free to do so, but could not expect the traditional protections of exclusive patent rights.

The Science Mobilization Act generated much more publicity and debate than its predecessor a few months earlier, which had been cast essentially as a temporary wartime measure. Unlike S. 2721, it was clear during this second attempt that Kilgore's protoindustrial policy agency would permanently reshape the relationship between the federal government and R&D, and radically alter the structure and distribution of industrial patents into the future. Now that the stakes had been raised, the hearings held during late March and early April included much higher-profile testimony. The first to appear at the hearings in favor of the bill was Thurman Arnold, now a judge on the US Court of Appeals for the DC Circuit. Arnold heaped praise on the bill, describing Kilgore's proposal as "the Magna Carta of science" that, if passed, would be "one of the greatest single events in the scientific development of this country." The primary focus of his testimony was, of course, the effect the bill might have on patent abuses and concentration. Aligning himself with Kilgore's position, Arnold argued that the war mobilization had been unnecessarily hampered by "the control of research and invention" by "domestic and international cartels." Section 7 of the proposed bill would fundamentally restructure the national patent system over the long run and "break the corner on research and experimentation now enjoyed by private groups."[xc] Arnold's opening statement included the following:

> Private research should be encouraged. But only the Government can preserve opportunity for the inventors and technicians who do not choose to work exclusively for the benefit of a private group necessarily trying to get control of the market if it can. This bill, S. 702, attacks, I think, the root of the evils of patent monopoly...The bill gives the Government authority to promote such research and make it available to the people as a whole...without discrimination.[xci]

A series of other witnesses centered their testimony on the potential for the OSTM to shift the patent system in a more fair and competitive direction. Clyde Ellis, a former congressman and supporter of Roosevelt, also invoked the threat of patent cartels run by "economic dictatorships," and argued that "as long as we have in this country a system of controlled patents and monopoly of industrial processes we cannot have free competitive enterprise."[xcii] Section 7 of Kilgore's bill would allow the proposed OSTM to break existing patent monopolies by developing new inventions for public use: "If we are going to have a high standard of living for the people of America...we must have a strong Federal agency which is charged with the duty of looking for the better things and making them available to the people at reasonable cost."[xciii]

In addition to the backing from New Deal-allied policy circles, the bill also garnered support from progressive scientists and science organizations. The American Association of Scientific Workers (AASW) backed the Science Mobilization Act, emphasizing the organization's interest in a more coordinated R&D system as well as patent reform. In an article published in *Science* magazine, AASW leadership praised S. 702 as "an admirable illustration of the manner in which science and its fullest utilization both for war and for peace can be 'planned' or coordinated for the benefit of the community without adversely affecting the research freedom of science." Various higher-ups within the organization would publicly promote Kilgore's ideas over the course of the next year. The AASW's national secretary argued in a conference speech that Section 7 of the bill would help combat the emerging "corporative control of patents," which were being used not for innovation but "for limitation of production, for limitation of invention, for adulteration of results."[xciv] Despite this level of enthusiasm, however, Kilgore's Science Mobilization Act also quickly developed a determined opposition. Leading this opposition were the very firms that perhaps stood the most to gain from the emerging science state.

NAM Rejects Kilgore

NAM had ignored Kilgore's first proposal (S. 2721), perhaps because the effort was largely seen as a wartime measure and was overshadowed by parallel attempts to establish a wartime R&D

agency within the War Production Board. NAM's records clearly show that the organization took S. 702 much more seriously. The Patents and Research Committee convened an emergency meeting in April of 1943, immediately following the first round of hearings on Kilgore's Science Mobilization Act. The Chairman of the Committee, R.J. Dearborn of Texaco, urged "the necessity of giving this proposed legislation serious consideration," and suggested that it would be a grave mistake to assume that the bill had little chance of passing and thereby not engage in efforts to lobby against it. "Industry men generally take it for granted that such measures are too radical and revolutionary to pass," Dearborn warned, "their lack of voice is accepted in many quarters at least as acquiescence with the proposal."[xcv] Among the Committee members present at the meeting, there was "unanimous opposition to the bill," with many members stating "that they disagreed with the premises on which it seemed to be based." Dearborn brought up the bill's patent reform provisions, suggesting that "the development of new ideas during peacetime requires a temporary monopoly such as is provided by patent protection or by secrecy and that the national welfare would not be benefited by giving everyone free access to technical information such as the sponsors of S. 702 seem to assume." The Committee determined that NAM's position on the Kilgore bill would be refined by General Counsel James Emery and by Patent Advisor George Folk. Once formulated, these positions would be "relayed to various technical societies, patent law associations, and other groups who are or ought to be interested in this subject." A multi-pronged attack was in the works.

Emery first issued a memo to the entire organization that would help frame NAM's response to Kilgore's bill and to the years-long debate over postwar science that would follow. The Science Mobilization Act, Emery argued, "conceals a most serious proposal of vital interest to American industry" despite its "appealing title."[xcvi] Unlike Kilgore's first bill, which Emery identified as “a loosely drawn measure in tentative form” that was “primarily directed to the war effort,” the proposal had now “been expanded into an elaborate and comprehensive measure with regulatory authority.” S. 702 was now a proposal for a fundamental restructuring of the role of the government in R&D: “The bill is therefore to appraise, assemble and mobilize the scientific, technical knowledge, facilities and personnel of the Nation.” Emery noted specifically that “scientific and technical facilities” included “all forms of property, tangible and intangible,” and that under the broad language of Section 7, the government was likely to acquire a “vast extent of property” since the OSTM would retain patent rights resulting from any project to which it made even a minor financial contribution. The “final effect” of the bill’s implementation, Emery concluded, would be

> a complete power of socialization of all forms of property, plans, methods, technical information, the ‘know how’ of all industries under the definition of ‘scientific and technical facilities’ and control of their major personnel of the power to authorize research, production and distribution under a guise of coordinating and developing scientific improvements.”[xcvii]

Emery, working in partnership with George Folk, further developed NAM’s response and published the organization’s definitive public position on the bill. In May, NAM released a report entitled *Shall Research Be Socialized?: The Kilgore Bill (S. 702) Analyzed by the National Association of Manufacturers*. Borrowing from Emery’s memo, the report framed the bill as “a comprehensive plan for the most ambitious project to socialize industrial research and technical resources that has ever been proposed in the United States Congress.” The proposed OSTM and its leadership would constitute an “administrative dictator,” possessing unprecedented “special powers” over all private research entities, including industrial labs and university research groups. The focus of the pamphlet, however, was largely on the question of ownership. Referring specifically to Section 7, the report warned of the OSTM's "power over patents," which would allow the Office to retroactively obtain patent rights in any government-funded project for the war and thereby to "destroy the fruit of the labors of those from whom the information was acquired by having the government itself develop...the project." By allowing the OSTM to acquire such a large number of patent assets, "the government would be put in a position of necessarily entering into extensive interference...with industry and with individual inventors." Such direct competition with the government would eliminate the incentive established by traditional patent law. In conclusion, drawing directly on Emery's memo, the report cast the bill as an effort "to authorize the complete socialization of all forms of property, plans, methods, technical information, and 'know how' of all industries and all personnel devoted to scientific and technical effort."[xcviii] Copies of the report were sent to Kilgore and all members of his Committee, and were circulated widely to policy writers and other business groups.

NAM's *Shall Research Be Socialized?* marked the first major public advocacy effort against the bill, and inspired a series of follow-up critiques published by individual NAM member firms and NAM-allied business groups. Several months after NAM released its report, the American Cyanamid Company, a prominent member of NAM's Patents and Research Committee, circulated "What's Wrong with the Kilgore Bill," a longer and more detailed piece than NAM's earlier statement that attempted to "put aside with generalities" that had been leveled against the bill and to "carefully and factually analyze" the bill's stated aims. It pushed back against Kilgore's assumption that industrial R&D had become overly concentrated and that the patent system had become a bottleneck to further technological progress. Critiquing the views expounded by the Temporary National Economic Committee, which the report suggests were aligned with Kilgore and his staff, the report claims that no such concentration existed and that patent rights were "widely scattered" across the economy.[xcix]

Based on the content of these advocacy pieces aimed at rallying opposition to S. 702 and the concurrent discussions held at NAM meetings, NAM understood Kilgore's proto-industrial policy proposal as primarily an attack on the patent system rather than a reorganization effort that would install a new planning capacity. Both NAM's report on the bill as well as American Cyanamid's accompanying piece dispute the assumption that wartime R&D had not been well-coordinated or had suffered from a lack of careful R&D planning. Noting the publicly disclosed achievements of Bush's OSRD, American Cyanamid suggested that "Never before in human history has there been such a triumph of scientific and technical research in the conduct of war." The report added that "thousands of projects are being considered under the guidance of the best scientific and technical brains in America" and touted many examples of scientific advances made thus far during the mobilization as proof that effective planning had indeed taken place.[c] Wartime R&D effort did not need to be more effectively "planned" because, in NAM's view, it was already planned.

Instead, as Emery suggested in his memo, the bill was instead seen as an effort to socialize the fruits of research through the "guise" of administrative streamlining. NAM was particularly suspicious of this aspect of the bill given the support it had accrued from prominent neo-Brandeisians. During one meeting of the Patents and Research Committee, S. 702 was identified specifically as "anti-patent legislation." Referring to Thurman Arnold's appearance before the Kilgore committee in support of the bill, NAM claimed that Arnold's support as well as the support of other prominent members of the Antitrust Division of the DOJ showed that S. 702 was "calculated in the main to sabotage the patent system."[ci] The threat of Kilgore's proposal to NAM's interest in preserving the existing patent system prompted the organization to increase its wartime public relations effort, already well underway, while emphasizing the importance of privately-run R&D in the war effort. In August of 1943, in between the first and second set of hearings on S. 702, NAM released a new booklet entitled "Testimony to the Future," which sought to highlight the successful wartime inventions of private industrial R&D thus far.

NAM's attack on the Science Mobilization Act spurred a flood of negative reactions to the bill on the part of business leaders and conservative-leaning scientists. By the time of the second round of hearings on S. 702, this opposition had been mobilized and Kilgore was put on the defensive. Despite favorable testimony during hearings held in October from several high-profile progressive figures, such as Assistant Attorney General Wendell Berge and Vice President Henry Wallace, Kilgore had failed to win the endorsement of the powerful American Association for the Advancement of Science (AAAS), an organization with 500,000 active members. The AAAS reacted primarily to Kilgore's effort to centralize all R&D efforts within a single agency—a reform that was seen as too "political" for the organization—and resolved that the bill "not be passed either in its present form or in any other form containing similar provisions." The American Institute of Physics, a smaller advocacy group with similar political leanings to the AAAS, opposed the legislation on similar grounds.[cii] By this time the popular press had picked up on the emerging controversy. *Newsweek* reported that "American science is split as never before by the so-called Science Mobilization Bill, presented by Senator Kilgore."[ciii] Kilgore was now facing hostile crowds while publicly campaigning for the bill, in some cases caught off guard by the vitriol of some of his audiences.

Though Vannevar Bush had initially been vaguely supportive of Kilgore's effort to extend government support for science into the postwar period, he and his elite cadre of wartime scientists had turned against the Science Mobilization Act by the end of 1943. In an open letter to Kilgore published in *Science* near the end of 1943, Bush attacked the proposal primarily on the grounds that some degree of centralization and coordination had been necessary during the war but would tend to stifle R&D if extended after the war's conclusion. While Kilgore's proposal favored political oversight over the direction of national R&D strategy, Bush preferred control by scientists themselves and suggested "an advisory scientific group, drawn on a voluntary basis from the best qualified scientific personnel of the country."[civ] Bush still agreed with Kilgore on the basic notion that government support for R&D was needed after the war, but this support should not come with "stifling control" because "science of the highest type flourishes best when it seeks its own objectives and pursues its own uninhibited ways."[cv] Bush also objected to Kilgore's vision for patent reform, preferring that any postwar science agency leave the existing system of contractor ownership in place. These splits would animate the debate that would emerge two years later over how to structure the National Science Foundation.

Meanwhile, with Kilgore's proposal looking increasingly unlikely to pass, NAM began to devise its own alternatives based on the assumption that the basic ideas in S. 702 were likely to be put forward again, perhaps by different policymakers. NAM Patents and Research Chairman RJ Dearborn warned that even if Kilgore were to abandon his proposal, "it should not be assumed that the ideas contained in it are dead. Further suggestions for legislation along this line should be expected and industry should be prepared to meet them."[cvi] To that end, NAM began to work with conservative members of Bush's cadre to develop plans for a "National Science Fund" financed cooperatively by private industrial firms that could function as an alternative to "socialization of fundamental research." The idea had originally come from Robert Millikan, President of CalTech, and had the support of Frank Jewett, an inner member of Bush's team. Acknowledging that private funding that had supported R&D in the past were "rapidly drying up" and that this would further open the door to new proposals resembling Kilgore's, NAM believed a privately-run fund operated on terms acceptable to industrial business could help fill this gap. Ultimately, NAM would not need to resort to such a measure to counter Kilgore's efforts: the Senator and his Committee had dropped the Science Mobilization Act by early 1944. "Men of science favor the bill," Kilgore believed, but overwhelming opposition from "vested interests, and those who are influenced or controlled by the vested interests" had thwarted its momentum.[cvii] A "resistance-to-change philosophy," paired with "the fear of lowered profits for the monopolies who control many patents" had forced him and his staff to rework their approach.[cviii]

Bush Intervenes

As Kilgore's ambitious proposal for a "proto-industrial policy" agency withered under attacks from business and conservative scientists, Bush seized on the opportunity and put forward his own vision for the organization of postwar state science. In late 1944, Bush worked with his contacts in the president's inner circle to draft an open public letter in Roosevelt's name asking for advice on government support for R&D after the war. Written by Bush himself, the letter framed R&D policy issues in a way that somewhat anticipated Bush's ultimate responses. Signed by Roosevelt shortly after his third reelection in November, the letter acknowledged the breakthroughs of Bush's OSRD and its crucial role in supporting the war effort. These successes prompted critical questions about peacetime possibilities:

> There is, however, no reason why the lessons to be found in this experiment cannot be profitably employed in times of peace. The information, the techniques, and the research experience developed by the Office of Scientific Research and Development and by the thousands of scientists in the universities and in private industry, should be used in the days of peace ahead for the improvement of the

> national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living.[cix]

The letter then called for recommendations on four major policy areas: first, how new technological and scientific knowledge developed during the war could be diffused into the civilian economy; second, how the government's commitment to medical research could be expanded; third, and most significant in the debate with Kilgore, how the government could aid "research activities by public and private organizations," asking for a careful consideration of "the proper roles of public and private research, and their interrelation"; and fourth, how education and training programs for young people could be further developed. As Bush biographer Pascal Zachary has pointed out, Bush's phrasing of the third question contained "critical assumptions" hidden in its simple language. By framing the question about government *to* external organizations, Bush "embedded" in the question the OSRD model of state-backed R&D, in which the government would form contracts with non-government researchers rather than carry out the research itself in government laboratories.

To give the recommendations a modicum of consensus, Bush formed separate committees for each topic area and asked each to develop their own ideas. He did, however, remain closely involved with each of them and actively sought to influence their direction. The committees were staffed mostly with university researchers and business leaders, including representatives from large R&D-intensive corporations. The committee for the topic of how the government could better support public and private research included representatives from Bell Laboratories, Polaroid, and Standard Oil. Bush synthesized each committee's recommendations into a short book released the following year entitled *Science: The Endless Frontier* (*SEF*). The book laid out a vision of the postwar science state that differed sharply from Kilgore's wartime proposals.

Scientific activity and R&D were critical to national security, public health, and perhaps most importantly, economic growth and dynamism, and a permanent government role as a promoter of science was therefore necessary. This role had to be carefully constructed, however, so as to avoid the excessive bureaucratization of R&D through state control.[cx]

The centerpiece of the report's policy recommendations was a proposal for a "National Research Foundation" (NRF) that would not seek to control private scientific initiative. As the relevant policy committee put it in its report, the NRF's "primary purpose is to provide encouragement, and where necessary, financial aid, without at the same time introducing centralized control of research," a qualification that appeared to respond directly to Kilgore's original proposals.[cxi] Unlike Kilgore's OSTM, the NRF would not be governed by a diverse interest coalition from government, business and labor, but rather by an elite board of scientists without immediate oversight by the legislative or executive branch. The target domain for the Foundation would be in basic science rather than the full R&D spectrum demonstrated by wartime agencies. Finally, Bush's proposal departed from Kilgore's on the critical policy choice of patent ownership. While *SEF* did concede that corporate concentration of patents had led to instances in which innovation had been stifled, the report affirmed that the patent system was "basically sound" and that "there should certainly *not* be any absolute requirement that all rights in such discoveries be assigned to the Government." The assignment of patent rights resulting from R&D projects "should be left to the discretion" of the NRF's administrators on a case-by-case basis, reserving government ownership for "special cases" in which the transfer of those rights would violate the public interest.[cxii]

Bush's flexible approach to government patent policy had been reinforced by a recent high-level report from the National Patent Planning Commission (NPPC), an investigatory group created by Roosevelt in 1941 to plan "for a full utilization of the Nation's expanded industrial capacity with the return to peace."[cxiii] NAM had initially feared that the NPPC would be a continuation of anti-monopolist critique of the TNEC, but ultimately chose to cooperate with the Commission and submitted the organization's own policy recommendations. In its report, "Government-Owned Patents and Inventions of Government Employees and Contractors," issued in early 1945, the NPPC recommended a "middle course" between state and private ownership of patent rights from state-backed R&D projects. Generally, the NPPC argued that the government should refrain from exercising the right to exclude conferred by patents and should instead enter them into the public domain. In certain contexts, however, development and commercialization would only be possible if private actors could use certain patents on an exclusive basis. The NPPC thus recommended that R&D-oriented government agencies transfer exclusive licenses to private actors "in cases where it seems evident that otherwise the inventions in question will not come into general use."[cxiv] The NPPC's report was a major victory for Bush and his allies and signaled that the support within the Roosevelt Administration for Kilgore's patent policy may have been waning.

Bush paired his advocacy in *SEF* with efforts to translate his ideas into concrete legislation. After meeting with Kilgore in early 1945 and signaling his willingness to explore joint legislation on a research foundation, Bush convinced the senator to hold off on any new proposals before the release of his report. However, Bush worked behind Kilgore's back with his congressional allies in the weeks leading up to *SEF*'s release and issued his own bill on the same day as the report's publication. Written by Bush and sponsored by Senator Warren Magnuson, S. 1285 called for the establishment of a National Research Foundation along the lines proposed in the concluding chapter of *SEF*, though discussion of patent policy was absent. Kilgore and his staff felt "double crossed" and were "mad as everything" by Bush's maneuverings.[cxv] They worked quickly in response and put forward a counter-proposal, bill S. 1297, which called for a "National Science Foundation" (NSF). Unlike his earlier proposals, Kilgore's NSF would not be permitted to operate its own labs. In keeping with the OSTM, however, the NSF would adopt a policy prioritizing government retention of patent rights, and would be able to license out these rights in order to generate revenue. Similarly, though Kilgore's NSF would be charged with formulating a national strategy for R&D and making recommendations to various agencies on how to pursue that strategy, the proposed Foundation lacked the compulsory powers to enforce an R&D strategy that Kilgore had suggested for the OSTM.

By countering Bush's proposal with his own version of a federally-sponsored research foundation, Kilgore attempted to maintain some of his earlier institutional commitments while conceding the larger vision. The many NSF proposals that would follow differed with respect to some key policy choices—for example, the governance structure of the Foundation—but all of them shared a markedly reduced ambition compared to Kilgore's earlier efforts. The NSF would not be the government-wide coordinator of a national research strategy, as Kilgore's OSTM would have been. Instead, it would be, in Kleinman's term, a "puny partner," just one among many R&D-oriented agencies run through the federal government. Despite the newly reduced scope of postwar science legislation, the NAM took an active interest in the debate between Kilgore and Bush on the institutional structure of the NSF. Though NAM was never a fervent supporter of Bush's proposals, always maintaining a certain degree of caution over the idea, the organization clearly opposed Kilgore's interventions and played a key role in undermining them, just as it had with S. 702. At a meeting of the Patents and Research Committee in the fall of 1945, NAM members recognized that though the competing bills were similar, "the Magnuson Bill is obviously designed to carry out the recommendations of Dr. Bush," while "the Kilgore Bill modifies these recommendations to meet the views of [Senator] Kilgore."[cxvi]

An analysis of the two bills prepared by NAM noted explicitly that "*the most important difference* between the Magnuson Bill and the Kilgore Bill pertains to inventions and patents." While Committee members noted that "the Magnuson Bill does not specifically mention patents," they believed its language was "broad enough to include patents," and this broad language "leaves the Foundation to do what it will regarding inventions and patents." Kilgore's NSF, in contrast, provided that "regardless of time, money or effort expended by an inventor, he could not retain any portion of the rights to his invention in case he had accepted anything whatsoever from the Government."[cxvii] Particularly noteworthy in the discussion of Kilgore's NSF was the Senator's continued links to anti-monopolist activists within the DOJ. NAM thus decided to endorse the Bush/Magnuson bill "in principle," but cautioned that it wished to see an even more flexible patent policy in a final bill. It disapproved of Kilgore's bill, noting that NAM "especially disapproves of [the section] of the Kilgore Bill relating to patents."[cxviii]

Following joint hearings on both bills in which Kilgore and his co-sponsors heard continued criticism of their bill's patent provisions from NAM leadership, Kilgore agreed to pursue compromise legislation with Bush and his senatorial allies. In a letter to Kilgore following the hearings, NAM Patents and Research Committee chairman RJ Dearborn sought to steer Kilgore away from his commitment to government patent ownership, arguing that such a policy would defeat the entire purpose of contract-based R&D since patent ownership was a major incentives for private firms to participate in these projects in the first place.[cxix] A compromise bill, S. 1850, was introduced in early 1946 and was quickly noted in the press as being "more conservative than the measure…[Kilgore] originally drafted."[cxx] Kilgore had finally abandoned his position on government patent policy and instead agreed to a provision stipulating that most NSF-generated patents would be placed in the public domain while allowing the NSF some discretion in the assignment of exclusive patent rights to private contractors.

This concession did not go far enough for NAM, however, since the Association preferred an NSF with total discretion over patent rights on a case-by-case basis. At NAM's urging, Senator H. Alexander Smith attempted to amend the bill's patent policy in this way, but failed to get the amendment passed. NAM pulled their support for the compromise bill and argued publicly that "research would be seriously hindered through unwarranted Government competition" if the patent policy were not altered. Though the bill passed the Senate, it died in the House. Commentators concluded that NAM was chiefly responsible for the bill's failure after the Association "got to the House committee to which the bill was referred and succeeded in smothering it."[cxxi]

NAM Evolves on State Science

Though it had initially supported the idea of a National Science Foundation established along the lines articulated by Bush, NAM had become more hostile to R&D legislation by 1947. Two recent developments drove NAM to become increasingly nervous about the NSF and related efforts. The first was a report issued in late 1947 by the US Attorney General on the subject of government-funded research and patents.[cxxii] In sharp contrast to the report issued by the NPPC two years earlier, the Attorney General's report recommended a uniform federal policy placing full title in the government, with the exception of certain cases in which private contractors made substantial financial contributions to the research. Government-owned patents would be made available to the public through non-exclusive licensing. If private firms failed to make use of the patents out of free-rider concerns, the Attorney General recommended that the government itself finance subsequent R&D programs itself rather than grant exclusive licenses. The report framed the proposed government title policy both as a means of combating patent monopoly and as a recognition of the public's equitable claim to patent ownership. This was a surprising revival of Kilgore's patent position, which had only very recently been abandoned by the Senator after the setbacks of the NPPC report and his own legislative failures.

The Attorney General's report set NAM into action again. The Patents and Research Committee quickly formed a new Subcommittee on Government-owned Patents, chaired by Standard Oil. This Subcommittee issued an official statement in late 1947 condemning the recommendations of the Attorney General and reasserting NAM's position that contractors should retain title to the results of government-funded projects. Since patent rights resulting from R&D projects were a major incentive for private contractors to participate in government-funded research, the Subcommittee argued that removing the incentive would result in "many cases in which the contractor best qualified to carry on the research desired by the Government would be reluctant to do so." The Attorney General's suggestion that government ownership could help break patent-based bottlenecks was based on a "baseless assumption that there is suppression of inventions," and that any patents that were not being commercialized by private firms were merely "not commercially feasible." As for the Report's more radical suggestions, including the idea that the government should take the initiative to further develop and commercialize unused patents, NAM's Subcommittee worried that "our system of free enterprise and private economy would be seriously set back" if these suggestions were put into practice. Interest in private development and research would suffer," NAM claimed, and "[private] financing of such work would become increasingly difficult."[cxxiii]

The second development that caused NAM increased suspicion of the NSF was an effort to revive elements of the original Kilgore plan in the Office of Technical Services (OTS) by then-

Secretary of Commerce Henry Wallace.[cxxiv] One of the few remaining liberal New Dealers left in the Truman Administration, Wallace had been a longtime advocate of government support for R&D and had testified in favor of Kilgore's protoindustrial policy measure. Looking back on the efforts of the Roosevelt Administration to alleviate the Depression, Wallace lamented that the New Deal's "greatest shortcoming" was that "it did not back scientific research the way it should have."[cxxv] In 1945, just as the debate over the NSF was beginning, Wallace established the OTS within the Commerce Department as a peacetime continuation of the War Production Board's R&D activities. The OTS would be able to fund R&D projects directly and would aim to disseminate German military patents—referred to as "intellectual reparations"—across the civilian economy. After consulting with Wallace and Kilgore on the issue, Senator J. William Fulbright put forward a bill to authorize the OTS and scale up its funding. Fulbright's bill called for the OTS to expand its activities in several ways: in addition to a new mandate to study industrial innovation and try to diffuse manufacturing know-how, the office would "evaluate inventions for commercial potential" and "develop them in federal facilities." The OTS would also focus on spreading know-how specifically to small manufacturers, in a somewhat similar fashion as the Agricultural Extension Service.[cxxvi]

NAM viewed the OTS as a trojan horse designed to revive some of the most meddlesome features of Kilgore's OSTM. While the Patents and Research Committee approved of the Office's attempts to disseminate German industrial knowledge after the war, it suggested that Fulbright's attempted extensions would introduce public competition with private industrial innovation. By mid-1946, in the midst of the battle over the NSF, the Committee identified the Fulbright bill as "the most disturbing of all the science bills which have been introduced." "If the Government is in the field of scientific research at all," the Committee determined, "it should be only for scientific or basic research and never for commercialization or development of any item."[cxxvii] For the next three years, NAM would issue public statements condemning Fulbright's various attempts to support the OTS through legislative action and would campaign for the Office's elimination. Though the OTS would survive and eventually be transformed into the National Institute of Standards and Technology (NIST) within the Department of Commerce, Fulbright's effort to expand the Office's scope was unsuccessful. Still, the effort itself alerted NAM to the fact that Kilgore's approach to federal R&D had survived NAM's attack on S. 702 and were still entertained in certain policy circles. In early 1948, certain members of NAM's Patents and Research Committee recommended opposing the NSF in any form because the battle over the OTS had demonstrated that government support for R&D would inevitably intrude on private initiative.[cxxviii]

Other developments within the Truman Administration, however, had prompted NAM to warm to government support for research and ultimately to endorse the final version of the NSF. In 1946, Truman established a "Scientific Research Board" to offer recommendations for federal support for science and make an official report following a two-year investigatory period. The Board quickly sought out NAM's recommendations "on the most effective methods for handling contracts for research given by Government to industry, on the relationship between industrial research, research carried out in governmental laboratories and any aid which may be given by the Government to research in academic institutions."[cxxix] NAM formed a Committee to collaborate with Truman's Board, working specifically with Board member Lyman Chalkley, an advocate of a coordinated R&D system who had testified in favor of Kilgore's original Technology Mobilization Act in 1942. NAM chose to cooperate with the Scientific Research Board and to delay a final decision on its endorsement of the NSF until the Board released its report.

In 1948, the Board issued its report, *Science and Public Policy*, authored by Board chairman John R. Steelman, with whom NAM had communicated repeatedly over the previous year.[cxxx] The report sought to provide an update to Bush's *SEF* from three years earlier in light of the emerging postwar situation. *Science and Public Policy* was a ringing endorsement of a robust federal support base for R&D, calling for an annual public investment of one percent of GDP for research. Up to that point, advocates of government support for research had only put forward absolute figures for public funding. Research funding as a fraction of GDP reflected the rising tide of Keynesian liberalism in the immediate postwar period, and Steelman's estimate would be used as a rule of thumb for years in the future.[cxxxi] Steelman had long believed that the emerging system was "too often haphazard, lavish and uncoordinated," and the report called for a "Federal Committee" that would "assist in the coordination and development of the Government's own research and development programs."[cxxxii] It did not, however, call for the establishment of a centralized R&D agency, and instead endorsed the NSF as a step in the direction of a more coordinated basic science system. Importantly, the report avoided taking a stand on government patent policy, noting that the topic had been addressed in previous studies. The report thus sought to renew the government's commitment to supporting R&D, but only in an aggregate manner—carefully avoiding some of the more controversial institutional choices that had defined earlier debates.

NAM responded to the Steelman Report favorably, and in light of what appeared to be some permanent presence of the government in R&D, finally decided to formally adopt a policy on state-backed research. In 1948, several meetings of NAM's "Subcommittee on the Government's Role in Research" were held in which NAM members debated which technological areas were best suited for public support and when it was appropriate for the government to step in. By the year's end, NAM had finalized its position, which officially acknowledged that the Government "has a natural interest in ensuring that adequate research be carried on in this country in such fields as national defense, public health and safety, and conservation of natural resources." While private research was noted as the priority, NAM's position did cede that "there are situations where…private industry cannot without financial assistance adequately pursue the particular research activity deemed to be essential," thus justifying public intervention. NAM thus imagined a kind of three-step system, in which the government would first rely on the private sector for certain research goals, and if that failed, it would contract with private laboratories to undertake the research. In the event that no private contractors agreed to participate in this research, the government would conduct the research itself as an option of last resort.

In a telling reversal, NAM also endorsed in its official position a mechanism for more effective planning and coordination of the federal R&D system. In its list of specific policy proposals for how to carry out NAM's broader vision for state-backed R&D, NAM suggested a "statutory Interdepartmental Board" that would be charged "with the function of coordinating governmental research activities." This was a very similar model to Steelman's "Federal Committee" in his 1947 report. NAM's Interdepartmental Board, however, would be linked to a permanent "Industry Advisory Committee" that could offer "broad policy advice" on R&D issues from the perspective of industry leadership.[cxxxiii] NAM imagined that Industry Advisory Committees could be formed in every major research-oriented agency of the federal government, and, working in a kind of federated system of business-government councils, these committees could help formulate a more coherent national R&D strategy. By the decade's end, then, NAM had broadly accepted a permanent role for the government in supporting R&D, and had even made gestures of support for increased coordination of the system in order to improve efficiency and reduce waste. While these recommendations were a far cry from the powerful centralized agency envisioned by Kilgore years earlier, they do demonstrate that NAM had evolved on the issue of R&D planning and had begun to entertain prospects for some degree of centralization and coordination.

After years of false starts and even Truman's presidential veto in 1947, the final version of the NSF came up for review in 1949, and NAM, now satisfied with the highly flexible patent policy outlined in the bill, testified in its favor. The bill was signed into law in the spring of 1950, ushering in a new era for government support of science and research. Just ten years earlier, industrial business leadership could not have conceived of the dramatic extent to which state-backed science would expand—initially as a means of winning the war, and then as an explicit strategy to promote postwar economic expansion. A fundamental shift had occurred in the relationship between R&D and the state, and industrial firms now existed in a world in which the government had become the major source of research investment across the economy. They adapted accordingly. But the NSF was only the beginning: in the decade to come, the federal R&D budget would continue to rapidly expand as the nation launched a new scientific arms race, one that would deliver technological miracles and reshape the federal R&D system in the process.

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[i] Mowery, David C., and Nathan Rosenberg. *Technology and the Pursuit of Economic Growth*. Cambridge University Press, 1991, at 124.
[ii] Nelson, Richard R. *National Innovation Systems: A Comparative Analysis*. Oxford University Press, 1993, at 40.
[iii] Kleinman, Daniel Lee. *Politics on the Endless Frontier: Postwar Research Policy in the United States*. Duke Univ. Press, 1995, at 69.
[iv] *Id.* at 52.
[v] Block, Fred L., and Matthew R. Keller. *State of Innovation: the U.S. Government's Role in Technology Development*. Routledge, 2011, at 7.
[vi] *See generally* Rhodes, Richard. *The Making of the Atomic Bomb*. Simon & Schuster, 2012.

[vii] Kleinman at 71.
[viii] Zachary, G. Pascal. *Endless Frontier: Vannevar Bush, Engineer of the American Century*. Free Press, 2018, at 115, 69.
[ix] *Id.* at 69.
[x] *Id.* at 68.
[xi] *Id.* at 91-92.
[xii] *Id.* at 111.
[xiii] Minutes of Meeting of National Modern Pioneers Executive Committee, July 18, 1939. 1411, Series 9, Box 191. NAM Collection, Hagley Library.
[xiv] *Id.*
[xv] Zachary at 118.
[xvi] Stewart, Irwin. *Organizing Scientific Research for War*. New York Times Co., 1980, at 221-222.
[xvii] *Id.* at 223.
[xviii] *Id.*
[xix] Zachary at 187.
[xx] Kleinman at 63.
[xxi] Kleinman at 109.
[xxii] Wilson, Mark R. *Destructive Creation: American Business and the Winning of World War II*. University of Pennsylvania Press, 2016, at 48.
[xxiii] *Id.* at 78-80.
[xxiv] Herbert Emmerich, quoted in: Brinkley, Alan. *The End of Reform New Deal Liberalism in Recession and War*. Vintage Books, 1996, at 175.
[xxv] *Id.* at 175.
[xxvi] *Id.* 235.
[xxvii] *Id.* at 230.
[xxviii] *Id.* at 176.
[xxix] Delton, Jennifer A. *The Industrialists How the National Association of Manufacturers Shaped American Capitalism*. Princeton University Press, 2020, at 138.
[xxx] Wilson at 101.
[xxxi] Wilson at 129.
[xxxii] Brinkley at 176.
[xxxiii] As discussed in: Whitham, Charlie. *Post-War Business Planners in the United States, 1939-48: the Rise of the Corporate Moderates*. Bloomsbury Academic, 2016.
[xxxiv] Delton at 147.
[xxxv] *Id.* at 155.
[xxxvi] Series 1 Box 127. NAM Collection, Hagley Library.
[xxxvii] Series 9 Box 153. NAM Collection, Hagley Library.
[xxxviii] Series 9 Box 151. NAM Collection, Hagley Library.
[xxxix] Hart, David M. Forged Consensus: Science, Technology, and Economic Policy in the United States, 1921-1953. Princeton University Press, 1998, at 130-131.
[xl] *Id.* at 130-133.
[xli] Wilson at 62.
[xlii] Wilson at 62.
[xliii] *Id.*
[xliv] *Id.* 250.

[xlv] *Id.* at 97-98.
[xlvi] *Id.* at 241.
[xlvii] *Id.* at 252-253.
[xlviii] *Id.* at 251.
[xlix] *Id.* at 251.
[l] *Id.* at 253.
[li] *Id.* at 262-263.
[lii] *Id.* at 254-255.
[liii] Hearings Before the Committee on Patents, S. 2303. Hathitrust. https://babel.hathitrust.org/cgi/pt?id=umn.31951d03671345g&view=1up&seq=11
[liv] *Id.* at 2.
[lv] *Id.* at 2-4.
[lvi] *Id.* at 8.
[lvii] *Id.* at 626.
[lviii] *Id.* at 639.
[lix] Series 9 Box 151, NAM Collection, Hagley Archive.
[lx] *Id.*
[lxi] Stewart at 231.
[lxii] September 10th, 1942: NAM Research Advisory Committee, Series 9 Box 151, NAM Collection, Hagley Library.
[lxiii] Maddox, Robert Franklin. *The Senatorial Career of Harley Martin Kilgore*. Cummings & Hathaway Publishers, 1981, at 78-82.
[lxiv] *Id.* at 51.
[lxv] *Id.* at 51-52.
[lxvi] *Id.* at 144.
[lxvii] Statement of Assistant Commissioner Corrington Gill, WPA Volume, at v-vi.
[lxviii] Interview with Ethan Harris, step-son of Herbert Schimmel. March 14th, 2019.
[lxix] NAM Series 9 Box 155. NAM Collection, Hagley Library.
[lxx] Kevles, Daniel J. *The Physicists ; The History of a Scientific Community in Modern America*, 1987, at 343; Maddox at 26.
[lxxi] Wilson at 78-80.
[lxxii] Maddox at 128.
[lxxiii] Maddox at 175.
[lxxiv] Maddox 179.
[lxxv] Maddox at 164.
[lxxvi] A & M 967 Series 1 Box 1, Harley Kilgore Papers, West Virginia University Library.
[lxxvii] Hearings on S.2721, "Technological Mobilization," United States Government Printing Office: 1942.
[lxxviii] Kleinman at 79.
[lxxix] Maddox at 56.
[lxxx] Kleinman at 80.
[lxxxi] S. 2721 Hearings at 280.
[lxxxii] Kleinman at 82.
[lxxxiii] Maddox at 62.
[lxxxiv] Kleinman at 81.
[lxxxv] S. 2721 Hearings at 67.

[lxxxvi] Kleinman at 81.
[lxxxvii] S. 702 Hearings at 1.
[lxxxviii] Kleinman at 83.
[lxxxix] S. 702 Hearings at 6.
[xc] Maddox at 62.
[xci] S. 702 Hearings at 9.
[xcii] *Id.* at 149.
[xciii] *Id.* at 149.
[xciv] Wang, Zuoyue. *In Sputnik's Shadow: the President's Science Advisory Committee and Cold War America*. Rutgers Univ. Press, 2009, at 32.
[xcv] April 12th, 1943: Minutes of NAM Subcommittee on Patent Legislation, Series 9 Box 152, NAM Collection, Hagley Library.
[xcvi] Series 1 Box 287, NAM Collection, Hagley Library.
[xcvii] *Id.*

[xcviii] Series 1 Box 287, NAM Collection, Hagley Library.
[xcix] *Id.*
[c] *Id.*
[ci] Series 9, Box 152, NAM Collection, Hagley Library.
[cii] Kleinman at 86-87; Maddox at 66.
[ciii] Maddox at 66.
[civ] Kleinman at 88.
[cv] *Id.*
[cvi] April 11th, 1945: Minutes of NAM Committee on Patents. NAM Collection, Hagley Library.
[cvii] Kleinman at 89.
[cviii] Maddox at 163.
[cix] Copy of a letter from Franklin D. Roosevelt to Vannevar Bush. November 17, 1944. National Archives Online.
[cx] Bush, Vannevar, *Science, The Endless Frontier, Report to the President.* July 1945.
[cxi] Kleinman at 95.
[cxii] *Id.* at 96-97.
[cxiii] Eisenberg, Rebecca S. "Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research." *Virginia Law Review* 82, no. 8 (1996): 1663-727. (Symposium: Regulating Medical Innovation.) at 1671.
[cxiv] *Id.*
[cxv] Kleinman at 89.
[cxvi] September 18th: 1945: “Comments on Pending Bills to Provide for a National Research Foundation” By George E. Folk, Series 9 Box 153, NAM Collection, Hagley Library.
[cxvii] *Id.*
[cxviii] “Recommendations of the Executive Group of the NAM Committee on Patents:”, Series 9, Box 153. NAM Collection, Hagley Library.
[cxix] October 17th, 1945: Letter to Senator Kilgore by RJ Dearborn. In response to a request by Kilgore at the conclusion of Dearborn’s testimony on Kilgore’s bill (S. 1297) and Magnuson’s bill (S. 1285). Series 9, Box 153. NAM Collection, Hagley Library.
[cxx] Kleinman at 124.
[cxxi] *Id.* at 126-127.

[cxxii] Eisenberg at 1673.
[cxxiii] "Comments and Recommendations to the Board of Directors; Committee on Patents and Research on The Attorney General's Report Entitled "Investigation of Government Practices and Policies" Series 9, Box 153. NAM Collection, Hagley Library.
[cxxiv] Wallace was a close ally to Kilgore, and at one point worked to give Herbert Schimmel a job after Kilgore's funding for his position ran out. Letter from Harley Kilgore; University of Iowa Library online. http://digital.lib.uiowa.edu/cdm/ref/collection/wallace/id/60771
[cxxv] Hart at 137.
[cxxvi] Hart at 141.
[cxxvii] March 6th, 1946: Minutes of meeting of NAM Committee on Patents and Research. Series 9, Box 153. NAM Collection, Hagley Library.
[cxxviii] April 28th, 1948: Minutes of the Meeting of the NAM Committee on Patents and Research. Series 9, Box 153. NAM Collection, Hagley Library.
[cxxix] April 9th, 1947: Minutes of Meeting of NAM Committee on Patents and Research. Series 9, Box 153. NAM Collection, Hagley Library.
[cxxx] Steelman, John R. *Science and Public Policy*. 1947.
[cxxxi] Hart at 163.
[cxxxii] Zachary at 338; Steelman report at 7.
[cxxxiii] Series 9, Box 153, NAM Collection, Hagley Library.

Chapter 3:

Into the Blue Sky:
The Space Race and the Decoupling of Patents and Planning

Following a lengthy and sometimes bitter battle over policy specifics, the final establishment of the National Science Foundation in 1950 cemented the peacetime role of the federal government in supporting the national R&D effort. But despite the efforts of Kilgore and other late New Deal planning enthusiasts, the NSF emerged as a "puny partner" in the fragmented "mosaic" of postwar R&D programs.[i] The federal R&D system relied on a host of R&D-oriented agencies, each of which pursued its own mandate irrespective of the others and without an overarching strategy emphasizing particular scientific or technological fields. Federal innovation policy was now robust—total outlays for federal R&D still dwarfed the pre-war status quo—but it was, in the terminology of the Truman Administration, "headless."

The following two decades would mark a period of profound transformation for the federal innovation system. This transformation, however, would be one of scale and not, for the most part, institutional renovation. With federal R&D support already on the rise in the early 1950s, policymakers' response to the USSR's successful satellite launch in 1957 would bring about a radical expansion of the postwar science state and the creation of new agencies that would play a central role in spurring American technological development in the latter half of the century. Cold war rivalry in the 1960s would deepen the federal government's commitment to R&D and, for the first time, elevate the nation's research capacities as a source of national mobilization and pride. The federal R&D agencies began to pursue certain technological projects for their own sake—they set out to achieve certain technological goals simply to prove that they could achieve them.

It was in this moment of post-Sputnik technological hysteria, in which research itself became a core feature of American political propaganda, that federal innovation outlays would hit their all-time peak as a share of national expenditures. But despite these unprecedented levels of overall R&D funding, the fragmented structure of the R&D system survived. The federal government perhaps reinforced fragmentation by creating new agencies that were even more specialized than the NSF and others. For the most part, industrial capital welcomed the post-Sputnik R&D explosion. NAM's new Research Committee, dominated by new high-tech firms that relied heavily on federal research agencies, celebrated the government's growing commitment to research and often sought to expand it further. Following the Sputnik launch, NAM responded positively to some calls for a revival of a Kilgore-esque centralized R&D program, though it did not outright endorse the idea.

The issue of government-funded patents, however, was an entirely different story. As the dramatic growth in federal research support resurrected the push to safeguard government-funded inventions within the public domain, NAM faced renewed attacks against the system of "contractor-take-all" that Vannevar Bush and colleagues had promoted during and after the war. Led by Senator Russell Long, these attacks framed the practice of contractor ownership as an outrageous "giveaway" to corporate power and sought to revive Kilgore's commitment to government ownership of R&D-based patents. With the battle over patent ownership now raging again, R&D-oriented industrial firms increased public advocacy and lobbying efforts to maintain access to government-subsidized intellectual property. NAM emerged as the dominant lobbying voice in new legislative disputes over government patent policy and helped ensure that Long's efforts were stymied. By the early 1960s, the tides began to shift back when the Kennedy Administration endorsed a continuation of current patent practices in federal R&D agencies. By the decade's end, "contractor-take-all" would be all but cemented as the default practice of nearly every federal R&D agency, NAM's long campaign to secure a pro-business government patent policy an established success.

NAM's evolving positions during this period thus further elucidate the positioning of industrial capital as federal R&D budgets reached the stratosphere. The two key institutional choices that had defined the struggle over postwar R&D during the 1940s—whether to create a decentralized or planned R&D system, and whether to transfer patent rights to contractors or to retain them in the government—now became *decoupled* in reform proposals during the post-Sputnik era. Calls for a new centralized planning agency, such as Senator Hubert Humphrey's proposal for a Department of Science and Technology, did not also include provisions for government patent policy reform, as Kilgore's Office of Science and Technological Mobilization had done. Likewise, Long's attacks on the practice of contractor-take-all were entirely separate from R&D planning. With these institutional choices no longer linked as they had been, NAM evinced a clear shift in the direction of support for a more planned innovation policy. With the debate over government patent ownership now shifting in its favor, NAM was free to explore options for research planning and took proposals such as Humphrey's more seriously. By the early 1970s, NAM had completed its reversal on planning and was now preparing a full-throated endorsement of a Japanese-style industrial policy that would have remade the federal R&D system. With the patent battle won, industrial firms turned once again to planning.

This chapter begins with an overview of the continued growth of the government's R&D apparatus under Eisenhower, and then its dramatic expansion under Kennedy during the ramp-up of the Space Race. I then discuss the ways in which this expansion pushed NAM toward an even more accommodating position toward government R&D, and in particular, toward new ideas for a more coordinated R&D system that had emerged in the aftermath of Sputnik. The chapter then details the revival of calls for government ownership of R&D-based patents, though now lacking the neo-Brandeisian impulse that had propelled earlier efforts, and describes NAM's successful efforts to stave off these new calls.

R&D Under Eisenhower

In the five years between the conclusion of WWII and the establishment of the NSF, a host of separate agencies filled in to support the technological fields that Kilgore had originally sought to place under the purview of a central R&D planning agency. These included agencies embedded in the military complex, including the Office of Naval Research (ONR) and the Research and Development Board (RDB), and also agencies with civilian mandates such as the Atomic Energy Commission (AEC) and the National Institutes of Health (NIH), now with a substantially increased budget.[ii] Even when the NSF was established in 1950, therefore, its role as a "puny partner" (in Daniel Kevles' characterization) among the broader pluralistic federal R&D system was further guaranteed.[iii] The establishment of the AEC in 1946 was particularly important to this effect, in that it removed from the potential scope of the NSF "the most lucrative and dramatic field in all of science."[iv] It was the ONR, however, that emerged as the leading basic research agency in the pre-NSF period. Created by Navy Secretary Forrestal in the closing months of the war, the ONR was given a permanent congressional mandate in August of 1946, while Bush and Kilgore were still battling over the NSF's institutional specifics. The ONR supported research in university and industrial labs via contract, and also maintained some of its own public laboratories. Its scope had increased considerably since its initial focus on applied research related to naval missions, and by 1950 the ONR was funding academic research in astronomy, chemistry, and biology, and specific projects "branched out into such unmilitary studies as meteors, the rare earths, and plant cells."[v]

Due to the outsized role of military-based R&D efforts that were already in operation, postwar federal innovation thus took on a decidedly military character even after the creation of the NSF. Amidst rising tension with the Soviet Union and the threat of communist insurgencies across the Third World following the triumph of the People's Liberation Army in China, military exigencies provided a sweeping justification for the pursuit of new R&D targets. The emerging "National Security State" (NSS) would remain a dominant pillar of the federal innovation system in the decades to come. David Hart has characterized this emerging trend as follows:

> National security would prove to be a potent justification for investments in science and technology and much else besides. The [ONR] in the late 1940s was a premonition of what was to come. ONR's renowned generosity and flexibility with respect to academic scientists bore little relation to the navy's apparent needs. When defense management was loose enough, national security provided a convenient pretext to move ahead with policies designed primarily to serve other ends. NSF, too, benefited from the belief that it would help to win future wars.[vi]

The outbreak of the Korean War triggered a rearmament program that included further outlays for already-existing military R&D agencies, including the ONR and RDB. By the conclusion of the Truman Administration, military R&D spending made up 90 percent of the federal R&D budget and more than half of all R&D carried out in the US, public and private sources included.[vii] The military R&D budget nearly tripled over the course of the Korean War the, and though military budgets and overall spending were reduced in 1953, military R&D budget continued to trend upward. This reflected the newly accepted belief that postwar American military hegemony—and effective containment of global communism—would require constant innovation in the technical means of asserting military dominance. The NSS and its various technological sub-agencies were now permanent fixtures of American political economy.

Though Eisenhower had campaigned on delivering "security and solvency" through modest rollbacks of federal spending targets, his administration would continue to increase the federal R&D budget in its early years. Innovation was a critical feature of Secretary of State Dulles' "New Look" defense strategy, which would seek to reduce overall expenditures through cuts in personnel and armaments while maintaining military dominance through the surgical use of high-tech weaponry and surveillance. A number of major R&D projects were carried out to bolster this strategy, including the development of an arsenal of ships powered by nuclear propulsion (the "Nuclear Navy"), and the continental air defense program known as Atlas that would carry out "massive retaliation" in the event of a Soviet nuclear attack.[viii] For the most part, the early Eisenhower Administration sought continuation of the NSS-oriented innovation system that had emerged earlier.

The Federal R&D Liftoff

In 1955, the Eisenhower Administration announced new investments in space research geared toward launching a small scientific satellite by 1957. The Soviet Union immediately countered with its own satellite program, and within two years had overtaken the American effort.[ix] Though the successful launch of the "Sputnik" satellite in October of 1957 caught the Eisenhower Administration by surprise, the President and his advisors responded with caution, interpreting the Soviet Union's achievements in space research as largely propagandistic and not immediately relevant to the military arms race and global balance of power. Eisenhower's chief of staff derided the notion of a "space race" between the two global superpowers as a "celestial basketball game," while General Curtis LeMay referred to the satellite as a "hunk of iron."[x] Eisenhower himself rejected the emerging anxieties—assuring the public that Sputnik "does not raise my apprehensions, not one iota"—and remained confident in the US' technical advantages over its rival.[xi]

Within a few days following the launch, however, the public's fascination with Sputnik quickly morphed into full-blown hysteria. For weeks, headlines detailed the Soviet achievement and tracked the course of the satellite as it crossed the globe. Americans believed Khrushchev's earlier prediction that Soviet economic and technological development would soon "bury" the US was now being borne out. Prominent intellectuals such as Hannah Arendt pronounced the satellite launch as an event "second in importance to no other, not even the splitting of the atom."[xii] Despite the Eisenhower Administration's cool assessments of Soviet military capacities, many people assumed that the USSR's newfound success in space would automatically translate to advanced weaponry; satellites, rockets, and missiles were blended in the public consciousness and linked together as a demonstration of technological dominance. Much of this hysteria was likely owed to the political maneuverings of the Administration's opponents. As interest in the satellite amongst the public increased, the Administration's downplaying of Soviet space capacities made it vulnerable to attacks from Democrats with presidential ambitions, including Senators John F. Kennedy and Lyndon Johnson, who warned of an emerging "missile gap" and sought to turn the American R&D effort into an issue of national pride and mobilization.[xiii]

Rising anxieties finally prompted the Eisenhower Administration to act. In early 1958, following three months of the Sputnik craze, Eisenhower announced during a State of the Union address his intentions to expand the federal government's R&D effort "to anticipate the unimagined weapons of the future."[xiv] In February, the Administration founded the Advanced Research Projects Agency (ARPA)—later renamed the *Defense* Advanced Research Projects Agency—a new independent R&D agency that reported directly to the secretary of defense.

Assigned a vague research mandate in its two-page founding directive and minimal bureaucratic oversight, DARPA was given unusual latitude in its pursuit of such "unimagined weapons." Many of the agency's early projects reflected the federal government's newfound tolerance for extreme levels of R&D risk-taking and ambition. An illustrative example is Project Argus, a DARPA-sponsored project to create a planet-wide nuclear force field designed to protect the US from incoming missiles. The idea was that if enough nuclear bombs were detonated into the earth's magnetosphere, the radiation might eventually form a new thin layer that could destroy cross-continental warheads heading for the US. In the summer of 1958, DARPA teams carried out three tests from the South Pacific and found that no sign that such a forcefield could be created. That same summer, DARPA greenlit Project Orion, a failed effort to create an interplanetary spaceship powered by nuclear explosions. The project was abandoned after details leaked to the public and DARPA leadership was forced to defend the screwball effort.[xv]

Eventually, many of DARPA's outlandish research projects would bear fruit. DARPA would go on to become one of the most critical agencies in the postwar federal R&D system, responsible for technological breakthroughs such as stealth technology, GPS, and perhaps most importantly, a proto-version of the Internet, known initially as the "ARPANET."[xvi] Most of these breakthroughs came after the agency transitioned in the early 1960s toward "counterinsurgency" technologies as the Vietnam War ramped up. Leading DARPA administrators intuited that the Cold War would be won through proxy entanglements rather than full-scale hostilities between the superpowers, and they accordingly steered the agency away from headline-dominating technologies like rockets and nuclear weapons and toward smaller-scale technologies. DARPA's primary engagement to this end was the R&D program based in Southeast Asia known as Project AGILE, an effort to produce technologies aimed at complementing guerilla warfare strategies.

While most of Project AGILE's new technologies never made it to the battlefield, the program's experiments in crop destruction led to the invention of Agent Orange, the biological weapon that the US military would deploy across the Vietnamese countryside until 1971.

As DARPA pivoted toward the technological shadows of counterinsurgency, a new space agency would come to dominate the public image of the nation's R&D system and play the central role in the emerging space race. Despite the efforts of DARPA's leadership to maintain some control over the space program, the Senate's new Special Committee on Space and Aeronautics, led by Lyndon Johnson, began to advocate for a new civilian space agency outside the purview of the military.[xvii] By April of 1958, building public enthusiasm—and anxiety—over the space race had finally triggered the Eisenhower Administration into action. Naturally suspicious of the growing "military-industrial complex," Eisenhower and his advisors agreed with the Senate committee that an independent civilian agency should be put in charge of the space program.[xviii] In a communication to Congress, Eisenhower concluded that a civilianized space program would better serve "national morale, and to some extent national prestige" than one housed within the NSS.[xix] The Administration submitted a bill to Congress that would establish the National Aeronautics and Space Administration (NASA), which would subsume the already-existing National Advisory Committee for Aeronautics (NACA) and expand its mandate substantially. The new Agency was up and running by the fall, with an initial annual budget of $100 million and immediate access to NACA's publicly owned testing facilities across the country.[xx]

NASA quickly began work on Project Mercury, a 277-million-dollar program that would result in the nation's first manned spaceflight mission. Meanwhile, despite Eisenhower's now active responses to the Soviet technological challenge, John F. Kennedy continued to use the space race as a political wedge to drum up support for his impending presidential campaign, still warning of a serious "missile gap" and urging the US to commit more resources into its space program. Reluctant to promote a revival of New Deal social welfarism and a new commitment to racial equality, both of which would be tentatively embraced later in the decade by the Johnson Administration, Kennedy saw NASA missions as a convenient temporary vehicle for political mobilization. Space exploration seemed to satisfy American liberals' hopes for a reinvigorated public sector and now-intensifying hostilities toward communism. By the start of his campaign in 1960, the space race had essentially become the leading theme of Kennedy's political project. The "New Frontier," Kennedy's answer to Roosevelt's New Deal and Truman's Fair Deal, sought to blend nostalgia for the ambitious projects of the 1930s and 40s with visions of the high-tech American future.[xxi]

Kennedy's victory in 1960 secured NASA's funding base and ushered in a further expansion of federal R&D spending. The decade that followed would be the high-water mark for federal research spending, which increased to nearly four times the pre-Sputnik annual average and peaked at 2% of gross domestic product (GDP) in 1964. It would also be the apex of civilian R&D as a share of the total effort, which had shot up from 20% in 1960 to just over 50% by mid-decade.[xxii] Any imagined ceiling on federal R&D spending had been lifted: Kennedy's moonshot, announced in early 1961, would end up costing over five times the Manhattan Project.[xxiii] For the first time, the federal government's R&D effort had become a political rallying cry and a basis for national political mobilization. Time Magazine deemed "American Scientists" its "Person of the Year" in 1960. During these years, research formed a core pillar of American propaganda during the high point of Cold War tensions. NASA's activities were widely broadcast as cinematic adventures of a daring crew of engineers. Astronauts became "space cowboys" in the public imagination, and individual pilots like John Glenn and Neil Armstrong became national heroes.[xxiv]

Just as DARPA would generate some of the most significant innovations over the ensuing decades, NASA's space missions would result in many spinoffs that had a major impact on the American economy. Examples include digital camera sensors, memory foam mattresses, improved aerodynamic designs for vehicles, air purifiers, and even enriched baby food.[xxv] NASA began to explicitly promote the use of its inventions in the civilian economy starting in 1964 when it launched its Technology Transfer Program. But the Agency's most important contribution by far has been in the field of satellites, which have served as the basic infrastructure for the US' information and communications technology (ICT) industries.[xxvi] Many key ICT innovations, including GPS, satellite TV, and mobile Internet, rely in part on the satellite system initiated by NASA.

As the decade came to a close, political support for the space race and the broader technological rivalry between the US and the Soviet Union had waned. Critics emphasized the immense cost of the Apollo program during a period of rising social unrest that highlighted the nation's overwhelming domestic problems. Further, the federal research system came to be linked in the public consciousness with the Vietnam War and American imperialism—appropriately so, given the still-outsized military share of federal R&D. DARPA's Project AGILE leaked to the public and prompted a swift backlash and elimination of the Agency's counterinsurgency program. University researchers and students, still a key pillar of the contract-based federal research system, staged revolts at major research universities across the country and in some cases forced administrations to cut ties with military agencies. By decade's end, the federal R&D heyday had come to an end. The space race had prompted a dramatic expansion of federal research outlays and the creation of leading new research agencies, but it had not fundamentally reorganized the R&D

system or cemented the enlarged role for civilian R&D. It did, however, initiate major changes in private industrial research and the attitudes of leading industrial firms.

The New NAM

NAM's policy positions and lobbying activities during this remarkable surge in federal R&D support were varied, but generally reflected the organization's accommodating attitude toward the new science state. Following the NSF's belated founding in 1950, NAM moved quickly to establish a new Research Committee, which would focus solely on the emerging postwar system of federal R&D agencies. Immediately following the passage of the NSF, during a Patents and Research Committee meeting attended by an unusually large number of industrial firms, committee leadership noted "increasing pressure exerted by many and diverse agencies for extension of Governmental activities in research" that now required "more adequate constructive recommendations by industry."[xxvii] Agencies such as the newly created NSF were expected to "extend and broaden their fields of endeavor," and to "demand for increasing appropriations," all of which would have a dramatic impact on industrial firms "whose life-blood flows from progress in basic and applied research." Aiming to work in collaboration with these agencies, the new committee would focus "on formulating constructive, concrete suggestions or programs which are in the best interests of the industrial progress of the nation." At the inaugural meeting of what would become the Research Committee in spring of 1950, the acting Chair of the committee, Randolph Major from Merck, listed as the primary motivation for forming the committee the fact that "NAM is an organization of manufacturers of which science is an important factor. Therefore, if NAM represents industry, science must be a part of its interest."[xxviii]

The Research Committee began its work focused on the newly created NSF and established a working relationship with the Foundation and its first Director, Alan T. Waterman. At the start of the Eisenhower Administration, the Committee noted the emerging trend of “enormously increased defense research” and adopted a wider scope to keep track of the federal government’s growing R&D commitments.[xxix] By late 1953, the quickly growing military R&D budget had become a cause for celebration. The Research Committee’s “Washington Report,” which included a run-down of recent R&D policy changes, lauded the fact that “business management has been injected into the Department of Defense.” The US military was described during this meeting as the “greatest production agency in the country,” now run by “men at the top with extensive experience in production.” Research Committee meetings members seemed to marvel at the favorable research environment generated by Eisenhower’s security-based R&D commitments and held Eisenhower himself in high esteem as a President with a deep appreciation for the role of research in the economy. Though NAM in general remained committed to fiscal conservatism, the Research Committee did not bemoan the “liberal attitude toward appropriations for research” demonstrated by the Eisenhower Administration. The Committee proclaimed during one meeting that “research men—scientists—engineers—are now the “miracle men” in the eyes of many Washington politicians,” and that military R&D as an implicit policy to combat economic slow-downs had become a broadly accepted notion.[xxx]

In the aftermath of Sputnik hysteria and its accompanying research surge, the Research Committee began to evince some concern over the ballooning federal R&D budget but never went as far as recommending actual cuts. In 1959, as R&D funding ramped up following the creation of DARPA and NASA, NAM issued a statement calling for cuts in nearly every civilian domestic policy area, including agricultural price supports, rural electrification programs, and even the veterans hospital program, but did not advocate for any reductions in civilian or military R&D funding.[xxxi] Instead, the Research Committee’s primary reasons for concern over the R&D budget during the space race was the manpower problem: that some of the new research outlays would go to waste if the US did not have enough trained scientists and engineers to staff the new agencies and participate in projects.[xxxii] The Chairman of the Research Committee noted in the wake of the Sputnik launch, "the people of the United States, in a sense, 'discovered' research." During this time, NAM also amended its "General Research Policy"—which had originated as its statement on the proper role of the government in research—to be broader and more permissive, revolving any listing of specific technological fields in which the government should involve itself. NAM signed on to the major projects of the space race, endorsing the creation of a space satellite system, though one ideally owned and operated by private corporations.[xxxiii]

NAM's newfound tolerance of bloated federal R&D budgets was perhaps some reflection of the organization's general turn toward moderation in the 1950s and 1960s. By the mid-1950s, the staunch anti-New Deal current within NAM leadership began to fade, yielding to more "corporate liberal" leadership that softened toward many forms of postwar government intervention and economic management. A formal split of some sorts occurred in 1960, when NAM broke formal ties with several higher-up members that had publicly accused Eisenhower of being a communist.[xxxiv] Following this incident, NAM hired a management consultant firm to "modernize" the organization's image, which essentially amounted to a purge of NAM's hardlined conservative members. The balance of power within the organization shifted toward politically moderate industrialists with close ties to the Eisenhower Administration such as General Motors' Charles E. Wilson, Eastman Kodak's Marion Folsom, and Proctor and Gamble's Neil McElroy, who played the leading role in establishing DARPA as Defense Secretary.[xxxv] Following reorganization, in 1962 NAM's new director Werner Gullander (General Dynamics) promoted a new campaign within the organization of "social responsibility" that urged member firms to develop private solutions to social problems. A year later NAM rolled out its "minority program" designed "to provide free market solutions to the current Negro employment problem" in order to combat the historically racist reputation of many leading industrial firms. Initially wary of a full-throated revival of New Deal liberalism under Kennedy, NAM pledged its cooperation with the Johnson Administration and even hailed his civil rights legislation as ushering in "the new era of industrial relations."[xxxvi] Though it remained committed to a highly conservative vision of social reform—one favoring associationalist solutions to social ills—the NAM's attitudes and rhetoric had clearly shifted.

A more immediate explanation for NAM's embrace of federal R&D, however, is that many of its members—and in particular, those firms represented on the Research Committee—were the direct beneficiaries of the Cold War research surge. Historian Jonathan Soffer has argued that the emergence of the military-industrial complex in the postwar years softened the attitudes of big business toward state intervention due to the new interdependence between many of the largest firms and military through the contractor system.[xxxvii] Federal innovation programs during the Eisenhower years and onward were one crucial element of this system. In some cases, already-dominant industrial firms such as General Motors and General Electric found new outlets for investment and profitability through collaborations with the military and the new R&D agencies. Reflecting at a NAM gathering on the new opportunities afforded by the dramatic increase in federal research spending, a Texaco executive announced that "research and development can well be said to be big business these days."[xxxviii] In a revealing speech given at a Research Committee meeting in 1960, a Dow Chemical executive explained his firm's recent shift in attitude toward government R&D partnerships. Entitled "Government Research: An Industrial Opportunity," the Dow representative noted "a recognition within Dow of the growing importance of Government research and development as an instrument of advancing technology." Whereas Dow had previously been reluctant to partner with government agencies on research projects, the firm now wholly embraced the new opportunities made available by the federal spending surge:

> We feel that [Dow Chemical] can benefit by doing business with [the Government] through the acquisition of knowledge and know-how positions; through the improvement of competence of personnel in specific areas; and through the reduction to practice of discoveries ahead of a demand created by commercial markets. In view of these benefits, we are willing to commit to long-range participation in Government research and development as long as the requirements of [the Government] continue to match our long-range objectives.[xxxix]

Other firms had also emerged, however, that based their entire business model on a quasi-permanent partnership with the federal government. Though many of these firms had been around well before the R&D revolution and the emergence of the science state, high-tech, military-focused R&D became the core business operation during this period and the federal government often served as the sole buyer. Unlike the industrial giants of the previous era, federal innovation programs were thus the *raison d'être* for many of these newer firms, and they were markedly more supportive of the quickly growing space race budget.

NAM's creation of the Research Committee is some reflection of this broader shift within industrial capital. The inaugural meeting of the full Committee in 1951 saw a much larger attendance than the Patents and Research Committees from a decade earlier, and now included many of these higher-tech military contractors such as General Dynamics, Sperry Gyroscope, Lockheed, and Raytheon, now a leading aerospace R&D firm after its humble beginnings led by Vannevar Bush and his colleagues. The R&D operations within these firms were large and flexible enough to permit collaborations with the most forward-thinking projects of the space age R&D programs. DARPA, for example, turned to Research Committee member RCA during Project

SCORE, an early effort to transmit voice communications through space.[xl] Most of the R&D activities involved in DARPA's Project AGILE, the agency's contribution to the Vietnam War, were contracted out to the Rand Corporation and other R&D-based firms.[xli] Stealth technology, perhaps DARPA's crowning achievement, would be DARPA-funded but Lockheed-developed.[xlii] As early as 1958, NASA initiated research partnerships with high-tech contractors such as Boeing, the Martin Company (later merged with Lockheed), and McDonnell Douglas. A revolving door of sorts quickly emerged between executive positions at the new R&D agencies and military-industrial leaders: for example, James Webb, NASA's director during the Apollo Project, had earlier served as Vice President at Sperry Gyroscope.

Beyond these direct connections, however, a fundamental shift had clearly taken place by this point that necessitated a change in the character of R&D-intensive industrial capital. Simply put, much of space-age R&D had reached such a high level of scale and complexity that even the giant industrial laboratories that emerged a generation earlier could not rationally undertake it. True "blue sky" innovation in the emerging fields of high-tech aerospace and information and communication technology required up-front resource commitments that no individual firm—or groups of firms, for that matter—could justify. During the same 1960 meeting where Dow Chemical extolled the newfound virtues of government R&D partnerships, a research director from Monsanto Chemical Company noted a shift in his firm's attitude driven by scale:

> Historically Monsanto has not participated in Government business except during [times] of war. We operated several plants during the Second World War, but withdrew as soon as the war was over, maintaining only our association as an operator for the Atomic Energy Commission. In the meantime, however, there has been a tremendous growth in technology. As a chemical company sitting on the sidelines it appeared to us that the physicists and electrical engineers working through Government contracts were making tremendous advances and in effect the chemical industry was sitting aside. A lot of this highly exotic chemistry was long term from the standpoint of the chemical research organization. It was hard to

> substantiate a research program of this nature within the company, but by [the mid-1950s] there was a growing interest in it from the company's standpoint.[xliii]

The speech then went on to describe a new Monsanto branch devoted exclusively to "exotic chemistry" in partnership with the government in order to offset the risks of this type of blue sky research. NASA's creation of the satellite system is another illustrative example: though it provided the critical infrastructure to an entire new technological field and opened up massive new investment opportunities for high-tech firms, none of these firms had the resources nor the tolerance for risk to create this infrastructure in the first place. Only the state could fulfill this function. This notion had become well accepted by members of NAM's Research Committee. In a speech at a 1961 Research Committee meeting on "NASA Programs of Industrial Interest," an Avco Corporation executive noted that while the emerging satellite system and the components of spacecrafts would surely involve partnerships with private firms, the state itself would need to continue playing a dominant role:

> ...the Government must continue to play the major role in research and development, even though private enterprise may take on some of the burden. NASA has the responsibility for investigating the technical aspects of the various proposed commercial systems to help in determining the most useful and economic...In addition, it appears certain that NASA will have to conduct all space launches and retain direct control over all launching equipment, facilities, and personnel to assure safety, equitable access, and for other practical reasons.[xliv]

At the same time, with American industrial firms facing little competition abroad and benefiting from buoyant international markets, the potential returns to research-intensive business strategies were greater than ever. Industrial research pioneers such as General Electric, RCA, and Kodak thus scaled-up their central research facilities dramatically in order to ride the wave triggered by the government's new R&D-based generosity.[xlv] Further development of new products and processes required R&D investments at an unprecedented scale—even more so for the creation of entirely new industries—and industrial firms were forced to accept this new reality.

Planning in the Space Age

The 1950s and 60s were a high point not just for industrial and government-led R&D, but for American capitalism writ large. The US' rapidly expanding consumer economy and dominant position over potential industrial competitors in Germany and Japan delivered years of stunning growth rates, culminating in the boom years under Kennedy and Johnson. Despite the war economy's partial revival of "planning" among policy elites, the rise of the Keynesian ideological consensus and the evaporation of concerns over a postwar return to depression conditions made earlier notions of structural management of the economy irrelevant. Though the two reformist currents had been closely associated during the New Deal, the triumph of Keynesianism in the postwar boom years brought about the nadir of centralized economic planning, its earlier advocates now converting to the new religion or retreating into academia. After a stint as the Governor of Puerto Rico, Rexford Tugwell migrated back to the university and helped found modern planning studies. He and a colleague lamented in the early 1950s that the nation remained "a long way still from the kind of comprehensive planning and action that is required if we are to conserve, develop and use our national resources."[xlvi] Otis Graham summarized the perspective of Tugwell and the New Deal planners during the postwar boom years as follows:

> Despite many gains for collective controls on social evolution, they found an unplanned society...a collection of federal agencies moving from year to year and problem to problem without central guidance...But their sense of disappointment found no resonance on the American Left. Planning was a road we had not taken, and there was no disposition to look back.

Indeed, liberal policy elites and commentators had chosen to pursue their primary economic goals of the postwar years—full employment and steadily increasing wages—through a mixed strategy of government-backed countercyclical management and industrial peace. Growth and employment had conquered all. The Truman Administration noted occasionally that the country no longer pursued any industry-specific economic strategy, though it did not act to develop meaningful planning goals. The Administration's 1952 Commission on Materials policy warned that key sectors of the economy such as energy were regulated by "a loose collection of independent pieces," and suggested that "the hydra heads of energy policy must be reined together" into a national program.[xlvii] Importantly, it made particular note of the federal government's rapidly expanding R&D effort and observed that the system was "headless" and lacked any coherent directional control. The ramping up of the Cold War cemented planning's demise. In Graham's telling, "Planning was not an issue, not a word that either party used. It was something the Russians did...To ask some contemporary what bearing the Eisenhower years had upon Planning would have been to call upon mental categories not activated since the 1930s."[xlviii]

The planning idea would make no comeback during the Kennedy or Johnson years. Kennedy was reluctant to commit to any major domestic programs, aside from those, like the R&D build-up, that were linked to the persecution of the Cold War. Before his assassination, Kennedy had begun to take seriously the idea of a broad anti-poverty program to be pursued through social welfare increases and tax reform, but had rejected the occasional proposal from within his Administration for more developed forms of economic coordination. Early on in Kennedy's tenure, New Dealer James Landis prepared a report for the Cabinet on the effectiveness of the regulatory agencies in which he recommended increasing centralization and coordination by establishing an "oversight" office that would coordinate the separate agencies.[xlix] Kennedy apparently agreed with the diagnosis in the report but took no action on it. Johnson's later expansion of social programs represented a revival and successful extension of the New Deal, though only with respect to its welfarist current. The dramatic postwar economic expansion had made this revival possible without any return to the commitments of the First New Deal.

Perhaps ironically, the planning idea would make a partial return in the Nixon years in the form of a "National Growth Policy" (NGP). Urged on by "liberal" advisor Daniel Patrick Moynihan, Nixon's advocacy for an NGP focused primarily on "urban development" and eventually boiled down to racialized suburban expansion through government-backed housing subsidies. Still, though unambitious when put into practice, the Administration's affinities did revive the planning idea itself. Moynihan declared "we are moving from program to policy-oriented government...In a system, everything relates to everything. If one part is changed, all other parts are affected. It thus becomes necessary to think of the total effect, not just the partial one." Moynihan's advocacy led to the creation of the National Goals Research Staff (NGRS), a planning-oriented research group housed within the White House that resembled a partial reincarnation of Roosevelt's National Resources Planning Board (NRPB). The NGRS, however, would have an even shorter lifespan than the NRPB: it was eliminated after publishing only one report, *Toward Balanced Growth*, which offered meandering discussions of different sectors and little in the way of concrete recommendations. Planning of the New Deal variety remained sidelined.[1]

The exception to planning's marginal status during the key policy debates of this period, however, was the contest over the structure of the federal R&D system. The period saw some efforts to rationalize the emerging mosaic of federal R&D programs and even some renewed interest in R&D planning along the lines explored by Kilgore and his allies in the 1940s. These efforts began with Truman's creation of a permanent Science Advisory Committee (SAC) in 1951 after the National Science Foundation finally got up and running. SAC was originally intended as a peacetime equivalent of the somewhat informal science advising system spearheaded by Bush and his colleagues under Roosevelt. SAC's first incarnation included a cross- Early on, SAC accomplished very little under Truman and became mired in controversy when SAC member J. Robert Oppenheimer fell victim to Joseph McCarthy's red-baiting tactics and suffered permanent reputational damage. SAC's only major activity in the remaining years of the Truman Administration was the publication of a short report, "Scientists and Mobilization: Some Views of the Science Advisory Committee on the Role of Academic Scientists," which essentially regurgitated the findings of Bush's *Endless Frontier* and the later Steelman report. Still, despite its origins as—in Oppenheimer's words—a "good-for-nothing committee," the creation of SAC set the precedent for a permanent institutional base for scientists and R&D-focused policy makers within the White House.

This system would fully come into its own under Eisenhower, who took seriously the recommendations of the committee, later renamed the President's Science Advisory Committee (PSAC) after Sputnik. The reconstituted committee had shed some of its former members and now included several industrial R&D experts with ties to major business organizations, including NAM and its new Research Committee.[li] PSAC played a key role in establishing the contours of Eisenhower's missile-defense strategy during the mid-1950s, which accelerated ballistic missile development in the US and increased funding for counter-intelligence.[lii] In the midst of the post-Sputnik hysteria, PSAC also served as the critical institutional voice resisting attempts to militarize US space research. Looking for "moderate" voices on the problem of the Soviet space rivalry, Eisenhower found an appealing perspective in PSAC's defense of a civilian response. PSAC had always interpreted the Sputnik launch as a technological and educational challenge rather than a direct military threat, and suggested that Eisenhower seek to deepen the US' commitment to scientific training and civilian R&D rather than launch another military ramp-up.[liii] PSAC survived into the Kennedy and Johnson Administrations, though in a somewhat diminished role from its post-Sputnik position of influence. The Committee met its demise under Nixon, as attacks on government-backed science from both the right and the left prompted a reorganization, but its basic function would be maintained under the Kennedy-created Office of Science and Technology (OST).

Whether this matured presidential advisory system contributed to increased coordination of the R&D system is, however, a separate question. For the most part, PSAC's recommendations during the critical Eisenhower years generally pushed back against attempts at moving the R&D policy mosaic toward a more planned system. An early example PSAC's response to the Bureau of the Budget's (BOB) 1953 attempt to centralize federal R&D policy by dramatically expanding the budget and statutory role of the NSF. BOB officials proposed a gradual transfer of all basic research funds from other agencies, including DoD programs, to the NSF, which would then become the "primary agency" sitting atop the federal R&D system. Additionally, BOB recommended broadening the NSF's mandate to allow it to evaluate other agencies' R&D programs and to make recommendations for budget adjustments. PSAC initially rejected the move based on the concern that centralizing R&D under the NSF would likely mean an overall reduction in R&D expenditures. The NSF was still underfunded during its early years—its 1953 budget accounted for just 3.5 percent of all federal funds for basic research—and PSAC as well as other administrators of federal R&D agencies worried that expanding the NSF's umbrella would simply mean budget cuts across the board.

PSAC leaders quickly developed a defense of the pluralistic status quo that went beyond concerns over just funding. PSAC issued a report authored by Lee DuBridge, president of CalTech, that synthesized the basic arguments made by Bush ten years earlier with newer concerns emerging out of the Cold War science struggle. Echoing Bush's attacks on Kilgore, PSAC issued a report that warned of increased regimentation of R&D if a strategy of centralization were pursued. The fragmentation of the existing system lent itself to scientific freedom, while efforts to further rationalize and coordinate research might stifle the innovative impulse.[liv] Breaking from Bush, however, DuBridge recognized the exigencies of the Soviet threat and suggested that R&D programs within the military be considered part of the country's "mobilization planning" that can ensure that "the general scientific strength of the country is maintained and improved."[lv] R&D for military operations should thus be better coordinated: "Let us not slice 'R&D' funds blindly; let us do better *military planning* so that R and D effort will not be wasted on useless projects." This embrace of further coordination of military research thus simultaneously worked as an endorsement of R&D pluralism across the board. By carving out an exception for R&D planning in the military context, DuBridge and PSAC sought to extend the domain of DoD agencies over basic research, insisting that this "diversity of support provided when several agencies are active is a valuable asset." Eisenhower responded favorably, issuing an Executive Order in early 1954 that designated the NSF "increasingly responsible" for basic research rather than the "primary agency," as the BoB and NSF had hoped. More importantly, Eisenhower endorsed a pluralistic model for federal R&D policy by deeming the research carried out by non-NSF agencies "important and desirable," and thus deserving of continued federal support.[lvi]

Kilgore Redux I: Humphrey's Push for Centralization

The debate over R&D centralization under Eisenhower had not been permanently settled, however. In the aftermath of Sputnik, just as the federal government was adding DARPA and NASA to its array of R&D programs, a new proposal led by Senator Hubert Humphrey for a “Department of Science Technology” (DST) again raised the possibility for a more centralized and planned R&D effort. Initially raised by congressman and R&D advocate John McCormack, the idea of DST appealed to Humphrey, who seized on it as a means of asserting his Cold Warrior credentials in the lead-up to a primary contest with Kennedy. Harkening back to Kilgore’s peacetime OSTM, the DST would centralize and coordinate all federal science activities and serve as a clearinghouse for scientific information, reflecting the emerging view that the government’s fragmented system was in some way responsible for the Sputnik surprise.[lvii] The push for a DST, which would have represented a major shift in control over R&D away from the National Security State, also appealed to critics of the ballooning military R&D budget who were wary of an escalating technological arms race.

Humphrey’s “Science and Technology Act of 1958” (S. 3126) called for the transfer of all existing R&D programs, including the NSF, to the administration of the new DST, which would then be charged with “the elimination of duplication of [R&D] effort through the integration and coordination of functions” assigned to the Department. Importantly, the DST would also absorb the federal Patent Office and all its functions, and would develop a “complete science information program” that would “translate, abstract, index, store, retrieve, and disseminate information essential as may be determined to be in the national interest and consistent with security requirements.” Finally, the new Secretary of Science would be given the power to establish a series of “National Institutes of Scientific Research” modeled after the already-existing National Institutes of Health. These new institutes would be similarly specialized in any field identified by the Secretary, and could include applied research in fields for which "sufficient economic incentive does not exist for the undertaking of such research by nongovernmental organizations without governmental support."

Hearings were conducted on the bill in May of 1958, and though it did not receive the publicity or amount of testimony of Kilgore's OSTM hearings, S. 3126 did find some supporters scattered across various government agencies and academic institutions. Senator Mike Mansfield advocated in its favor, decrying the increased militarization of R&D since the Korean and urging that the Pentagon "is not a good site for the control and direction of creative scientific research."[lviii] National Bureau of Standards scientist Wallace R. Brode testified in support and highlighted the emerging view among government scientists that federal-backed research had deteriorated in the immediate postwar period. For his part, Humphrey published an advocacy piece in the *The Annals of the American Academy of Political and Social Science* in which he acknowledged major steps forward in the creation of new R&D agencies but warned of "still existing inadequacies not only in these agencies but in other areas which must be coordinated with operations of a similar or related character and reorganized under more cohesive administrative controls." The primary goal of S. 3126 was thus "coordination and centralization of those federal activities now scattered among existing departments, as well as those which had grown haphazardly following World War II in the field of civilian science."

Given the ambition of Humphrey's proposal, NAM was conspicuously silent on the bill, issuing no public statement and sending no statements or testimony to the hearings. Internal deliberations of the Research Committee reveal, however, that NAM had become amenable to the idea in the immediate post-Sputnik period. Earlier on in the Eisenhower Administration, NAM's Research Committee had already been developing proposals, led primarily by Randolph Major of

Merck, for a permanent industry-government advisory body that would work closely with the NSF and PSAC to streamline the government's R&D efforts and reduce wasteful spending.[lix] The Committee saw Eisenhower's 1954 Executive Order calling for an enlarged role for the NSF as some vindication of these efforts.

By the time Humphrey's proposal for a DST emerged, NAM was prepared to take a major overhaul of the federal R&D system quite seriously. In early 1959, the Research Committee held a meeting solely devoted to the question of whether a DST was necessary and whether NAM should back Humphrey's proposal. One speaker at that meeting, Clifford Rassweiler of the Johns-Manville Corporation, delivered a full-throated endorsement of the DST and urged the Committee as a whole to do the same. Noting that "there is no central research and development activity concerned with matters of over-all Government interest," Rassweiler suggested that the existing pluralist system of separate agencies had produced a system in which "fragmentation of responsibility is so great that really effective common action cannot be achieved."[lx] Rassweiler concluded his speech by framing a more centralized and planned R&D system as potentially more profitable for R&D-oriented firms:

> The Government is spending tremendous sums of money on research and development. Industry is paying a considerable portion of the bill. Industry can profit greatly if this money is spent in a way which will produce maximum results. Businessmen should carefully consider the advisability of giving support to the bill Senator Humphrey has introduced...The chances of really doing something constructive in the field of improving research and development in the Government are probably as good now as they will be for a long time to come.[lxi]

Following Rassweiler was retired general James M. Gavin, now a VP of the Arthur D. Little Company. Gavin delivered a similar endorsement of the DST, which he described as necessitated by the technological advances of the USSR. Having "seen too much fragmented research and duplication in research and lack of application in areas that we should have been into," Gavin urged NAM to consider endorsing Humphrey's proposal in order to achieve a "higher degree of integration of our scientific effort, a higher degree of integration of our economic effort." In short, the US research system would have to become more Soviet in order to compete with the Soviets.

Though some of its members lobbied the Research Committee to back Humphrey's proposal, NAM's formal attitude toward the bill was never resolved or made public. This is likely due to the fact that Humphrey's DST never progressed to the advanced stages of consideration, as Kilgore's proposals had in the previous decade. Unlike that initial attempt at R&D planning, Humphrey's proposal fell prey to resistance from within already-existing government R&D agencies and, critically, from the leadership of PSAC. Eisenhower's science advisors had been satisfied with the R&D boom following Sputnik and were ambivalent toward the idea of a DST as a possible means of cutting back on funding. After Humphrey announced his proposal, PSAC created an investigatory panel chaired by PSAC member Emanuel Piore, the first Director of Research at IBM. Piore's group conducted a series of hearings of its own with representatives from several agencies involved in R&D, including the NSF, DoD, and AEC. The panel ultimately agreed with Humphrey and other DST advocates that the federal R&D system did require some further level of coordination, but primarily as a means of avoiding neglect of certain under-funded fields, such as the geophysical sciences.

The Piore panel stopped short of endorsing a DST, however. Such a major reform would, in the panel's view, run into practical difficulties, as each specialized R&D agency could not easily be administered by a centralized body. The panel also argued that the scientific community was against the idea, pointing to a recent statement of the American Academy of Art Sciences opposing the bill. Piore himself defended the panel's position in a speech to NAM's Research Committee. By transferring R&D-oriented activities of various departments and agencies into a DST, Piore warned that specialized knowledge embedded in these institutions would be jeopardized:

> You cannot have a real Department of Agriculture and take all its science and engineering out of it. You cannot remove science and engineering from, say, the Bureau of Mines, the Geological Survey, the Fish and Wildlife Service. If medical research is removed from the Department of Health, Education and Welfare, you will just wreck the Department. Just as in any large corporation with independent divisions, you have to have the division perform its own engineering work, and you want this work done with distinction. Men in the Departments who are operating in the field to serve the nation must have their own scientific and engineering activities. This stresses the need for coordination rather than control under one department.[lxii]

PSAC as a whole adopted Piore's position on the DST, though the proposal did have some support from individual members. In the place of a DST, PSAC instead backed Piore's idea for a "Little Cabinet" for science and technology that would function as an additional advisory unit in parallel with PSAC. This "Federal Council for Science and Technology" (FCST) would be made up of representatives from each of the eight departments and each agency with substantial R&D activities and would report to the president on issues of R&D strategy through the PSAC as an intermediary. After some initial reluctance, Eisenhower approved the creation of the FCST and thus expanded the purview of the science advisory system while halting momentum for a more powerful DST. Humphrey remained committed to the idea, however, and made a second attempt at a DST in 1959, this time lowering his ambitions to establishing only a commission to study the possibility of a DST. This too failed to launch, as PSAC and other DST critics could now point to the FCST as a means of increasing coordination of the federal R&D system. Notably, Humphrey's proposal of an exploratory commission now had meaningful support from NAM, with the chairman of the Research Committee testifying in its favor.[lxiii]

Just as in the early debates over the structure of the NSF, this renewed push for a centralized research policy failed to overcome opposition to reform. This time, however, opposition came primarily from PSAC and the incumbent R&D agencies that comprised the postwar system rather than NAM and powerful business interests. Instead of a DST that bore a resemblance to Kilgore's OSTM, the pluralist system was allowed to survive with the added feature of an advisory office, first in the form of the PSAC and later the OST. In a striking shift from its position on the Kilgore proposals, NAM had remained somewhat neutral toward Humphrey's call for a DST. Evidently no longer troubled by "dictatorial control" over research that a centralized R&D system might entail, NAM approached the DST carefully and considered some of the arguments in its favor. This perceptible shift in favor of R&D planning may be a reflection of NAM's general shift toward political moderation, particularly in regard to federal outlays for R&D. This shift would not, however, extend to all features of the postwar innovation policy: NAM remained wholly committed to its earlier position on the issue of contractor ownership of patents, an issue that erupted again in controversy at the start of the space race.

The Patent Battle Reignites

Not long after NAM's victory in the government patent question of the NSF, industrial R&D firms scored perhaps their most significant legislative triumph since the New Deal popularized suspicions of corporate patent practices. The 1952 Patent Act was the first comprehensive legislative overhaul of the patent system in over a century, and it worked to reestablish many of the pro-corporate principles that had been under assault by New Deal-appointed judges since the late 1930s. The Patent Act now required patents to include definition of infringements, leaving less discretion to progressive judges who were often reluctant to find against infringers. The Act also formally recognized industrial processes as patentable subject matter, whereas before industrial patent holders had to make the sometimes difficult argument that certain production processes constituted an "art" in the 18th Century meaning of the term.[lxiv]

NAM played a key role in developing initial versions of the Patent Act and strongly approved of its final passage. In 1949, the leadership of NAM's Patents and Research Committee was invited to join an external advisory group working with the House Subcommittee in charge of patent reform proposals. This "Coordinating Committee" was made up of legal scholars and industry representatives, and NAM sent as its representative George Folk, the lawyer who had spearheaded the anti-Kilgore crusade several years earlier. Through Folk's work NAM was able to exert considerable influence over the drafting process; NAM leadership noted in 1950 that already "many of our recommendations have been incorporated" into the latest iteration of the bill. Whatever remaining differences by this time between NAM and the drafting committee were "not of a substantive nature" and could be overlooked.[lxv] In the leadup to the Act's passage, NAM's Patents Committee celebrated the fact that the drafters had "shown a strong desire to consider the attitude of industry" in the process.

While the Association still had some concerns about the "left-wing group that would like to change the patent system" and about "the spirit of antagonism to industry, so prevalent in committees controlled by New Dealers"—a clear reference to the TNEC—the policymakers behind the Patent Act were clearly interested only in refining some of the administrative bases of the patent system and not in fundamental doctrinal reform.[lxvi] Indeed, the neo-Brandeisian attack on the patent system, embodied by Thurman Arnold and a host of New Deal jurists, had been in retreat for some time. The industrial mobilization in partnership with big business during the war had halted the neo-Brandeisians' momentum and brought a swift end to the "Second New Deal." Following the startling revival of conservatism nationwide in the late 1940s, progressive New Deal judges that had developed a critical approach to patent enforcement soon found themselves losing influence to a new generation of more conservative-leaning judges. The same pattern held for policy circles and congressional investigations. In a Patents Committee meeting in early 1952, just prior to the passage of the Patent Act, one of NAM's chief lobbyist celebrated the new climate in Washington in reference to a recently aborted patent monopoly investigation:

> Well, it appears that the drive of radicals for drastic legislation to overhaul the patent system has been phased out for the time being. If the schedule had been kept, you probably would have been in the middle of a struggle against drastic legislation emanating from the House Monopoly Committee. An investigation of the patent system—and to many left-wingers in Washington this meant an attack upon it—accompanied the inquiry into anti-trust laws...it appears that the attack has been phased out until after the next election. A more pronounced left-wing Congress would see a revival of the drive to revise the patent system.[lxvii]

Despite this victory in doctrinal patent reform and a clear shift toward a more favorable political climate, NAM soon found itself on the defensive again on the matter of government patent policy. Two reforms to the patent practices of major federal R&D agencies—the Atomic Energy Act (AEA) of 1954 and the NASA Space Act (Space Act) of 1958—both included provisions to maintain public ownership of government-funded intellectual property. In the case of the AEA, the original Act in 1946, which first established the Atomic Energy Commission, included a requirement for government retention of patent rights based primarily on security concerns. NAM had advocated in the intervening years for an amendment to the AEA that would allow for atomic energy patents to be privately owned and commercialized. A round of amendments did come in 1954, but the public ownership provision remained in effect. NAM representatives testified during congressional hearings to amend the Act, but they were met, in the view of the Research Committee, by "strong resistance of such a program on the part of New Dealers" who "want the Government to retain a monopoly."[lxviii] Anticipating the rhetoric of future debates during the space race, NAM's Research Committee described opposition to privatized atomic patents in frustrated terms: "They assail the legislation as a 'give away.' They want restrictions on patents, they want unlimited Government authority to enter into production of electricity on a commercial scale with preference to public bodies, and they want the Government to remain in the atomic energy field in many respects to the exclusion or detriment of private enterprise."[lxix] NAM had missed an opportunity to privatize atomic energy patents.

The Space Act was an even greater setback. Under Section 305(a), the broadly worded baseline policy of federal space research would be public ownership of "any invention" "made in the performance of any work under any contract of the Administration." Since a greater number of NAM's member firms could conceivably take part in space research than in atomic research, the retention of all NASA-related patents by the government was a more significant threat. NAM's high-tech members were also well aware of the commercial potential of NASA-originated innovations. In an address entitled "Dissemination of Industrially Useful Space Technology" given to the Research Committee in 1961, a representative from the Midwest Research Institute reviewed a long list of new technologies developed at NASA in just the first three years of its existence that might be of interest to NAM members. These included new high-speed cameras, high-strength industrial materials and cables, and even proto-versions of solar-powered electric panels. These space-ready technologies, according to the NAM member, could be readily applied in manufacturing processes:

> Thus far we have found, with few exceptions, ideas that are applicable to the technical needs of the firms we work with...However, many firms simply do not identify themselves as potential beneficiaries of the space program. They say "what has my business got to do with space" and we tell them it's the other way around––"space has something to do with your business."[lxx]

Given this broad potential use in industrial applications, it was critical for NAM to ensure that NASA's patent policy permitted commercial spinoffs. In a self-published summary of its work on the Space Act, NAM noted that it had participated in "numerous conferences with government officials and other intensive Committee activities," which "succeeded in modifying the worst features of the original proposals" in NAM's view. In response, NAM's Patents Committee—now independent of the Research Committee—launched a major lobbying effort to amend NASA's patent policies. Within months of passage of the Space Act, the Agency's administrators had already noted that they were not satisfied with the existing patent policy, and Congress had created a new subcommittee to investigate NASA's patent policies. Representatives from NAM's Patents Committee appeared at several hearings and advocated for "the correction of this major roadblock to progress in space research." By mid-1960, NAM's advocacy resulted in an amendment to the Space Act that permitted R&D contractors to retain patents. NAM had successfully spun the issue into a debate over "fostering private enterprise" in the emerging space program, and the House moved quickly to approve the amendment.[lxxi] This began a steady liberalization of NASA's patent policies, which by the middle of the decade were designed to actively promote the private commercialization of NASA spinoffs. NAM's advocacy in the formative period of NASA policy was critical in initiating this shift.

NAM saw in both the AEA and Space Acts a revival of the Attorney General's troublesome 1947 recommendations for government patent ownership, noting the connection in a public pamphlet on "Patent Rights Under Government Contracts." Though NAM's preferred policy of contractor ownership was still in operation at the NSF and DoD, the concern was that this partial revival of government title could portend a domino effect just as the federal research effort—and with it, opportunities for industrial contractors—were being massively scaled up. NAM's chief lobbyist expressed concern in early 1958 that "Allegations that corporations gain an unfair knowledge, through patents or know-how, from Government research projects, continue to be heard now and then in Congress...sooner or later there will be legislation on the subject of patents growing out of research and development contracts."[lxxii] The policy battle over space age patents had drawn more public attention to the issue, triggering a renewed debate over government patent policy that would rage on for years to come.

Kilgore Redux II: Long's Assault on Contractor-Take-All

By 1959, government patent ownership had found a vocal proponent in Senator Russell Long, who waged a decade-long campaign against the still dominant practice of "contractor-take-all." Long was the scion of the powerful political family that had dominated Louisiana for decades with a populist economic bent, and as a young senator in the late 1950s he was eager to attach himself to issues that were intuitively linked to notions of economic unfairness and corruption. The system of intellectual property transfer that had become a core feature of federal R&D policy since WWII was, in Long's view, merely a corporate "giveaway." R&D agencies were subsidizing already dominant firms—most of which had ample resources to fund their own R&D—and allowing them to externalize risk onto the state. But the most egregious feature of the "license" policy in the R&D system, according to Long, was that the public would have to "pay twice" for the commercialized spinoffs from R&D agencies: first as taxpayers supporting the upfront R&D, and then as consumers purchasing the final product. In the opening session of his investigation into government patent policy on the Small Business Committee, Long noted that extraordinary increases in the federal R&D budget in recent years and suggested that "[the] American people foot the bill. Do they receive commensurate benefits from this work?"[lxxiii] Long's solution, which he would advocate for over the course of the 1960s through a number of bills and amendments to existing policies, was to simply establish an across-the-board "title" policy for all federal R&D programs.

Long quickly became NAM's new *bête noire*. NAM identified Long as the leading obstacle to Senate approval of the House's 1960 amendment to liberalize the patent provisions of the Space Act.[lxxiv] The Association's Washington lobbyist lamented Long's obsession with government patent reform "in spite of the great industrial growth of Louisiana, which is due in great measure to the research activities of corporations."[lxxv] The Senator's investigations of government patent policy had veered into familiar and troubling territory for NAM: not satisfied only with correcting the ill-conceived "contractor-take-all" status quo, Long had also begun questioning the very legitimacy of the patent system as a whole. During his first patent-focused Senate hearing in 1959, Long invited testimony from Seymour Melman, a radical critic of the patent system and the emerging military-industrial complex. During his back-and-forth with Melman, Long suggested the need to revisit some of the basic assumptions justifying private patent rights, and Melman asserted his view, expounded in articles and books over the ensuing decades, that the modern rationalization and professionalization of R&D had made patent rights unnecessary. This exchange clearly spooked NAM, which published a retort to the Melman discussion in its pamphlet defending the license policy.[lxxvi] At a meeting of the Patents Committee in early 1960, NAM's Washington lobbyist sounded the alarm:

> The attack on the Patent System may now be said to be actually in progress, after years of sniping. Within the last several weeks, Professor Melman has delivered his attacks on the system before two Congressional committees...Senator Long...voiced dissatisfaction with the Department of Defense policy of permitting contractors to retain patent rights, subject to a free license to the government. His views are somewhat extensive. In effect they are that the Government pays for research and consumers should have the benefit of any products discovered as a result.[lxxvii]

Fearing a revival of the anti-monopolist critique of patents fused with Long's populist assault on NSF and DoD patent policies, NAM immediately sought out new congressional allies that could be counted on to protect the patent transfer system. Senator John McClellan, leader of a newly created Subcommittee on Government Patent Policy, soon put forward a "flexible" alternative that would codify the *de facto* regime allowing each agency to develop its own patent policies, which NAM publicly endorsed and supported through testimony at congressional hearings. Originally, NAM had favored proposals from Senators Saltonstall and Dirksen that sought a uniform contractor-take-all policy across all R&D agencies. In a questionnaire sent to 230 NAM member firms, the vast majority preferred this uniform "license" approach while only 2% supported McClellan's defense of the status quo (only a single firm supported Long's proposal). Realizing that Long's campaign was gaining momentum, however, NAM pragmatically chose to back McClellan. Representatives from NAM's Patents Committee appeared at a number of hearings on the issue in the ensuing years, always favoring the "flexible" approach advocated for by McClellan, and helped organize the Chamber of Commerce and other scientific organizations to support the approach as well.

Just as the debate over government patent policy was intensifying in Congress, action from the Executive gave NAM the upper hand. In a 1963 Presidential Memorandum, the Kennedy Administration formally endorsed the "middle ground" solution that McClellan had been developing. The Memorandum identified a number of circumstances in which government ownership was appropriate, including research concerning public health and technological areas for which the government has been the sole funder.[lxxviii] Even in those cases, government agencies were urged to make these patents available on a nonexclusive basis. Agencies were encouraged to allow contractors to acquire patent rights in situations that yielded commercial possibilities, so as to "call forth private risk capital and expense to bring the invention to the point of practical application." Contractors that were given exclusive licenses—the highest form of patent protection available in government-funded R&D—now had to provide written reports to the government on the commercial potential of the inventions. The Memorandum thus gave agencies considerable discretion in dealing with their own patent policies and assigned minimal new obligations on contractors. Though it largely preserved the status quo, the Memorandum was seen as a compromise policy and thus sapped the momentum of Long and others agitating for more sweeping reforms.

The Memorandum also recommended that the FCST, now less active under Kennedy but still in operation, conduct a more thorough study of the topic and submit recommendations to Congress. In 1965 the FCST established a Committee on Government Patent Policy, which commissioned the independent research group Harbridge House to conduct the study and report its findings. After an eighteen-month investigation, Harbridge House issued a report to the FCST that would have a major impact on patent policy in the next decade. Essentially, the report suggested that government-funded patents were being dramatically underutilized commercially, and that a primary cause was that contractors often lacked title to commercializable inventions. As legal scholar Rebecca Eisenberg has pointed out, however, the Harbridge House data may have overrepresented the types of research within the DoD that were not conducive to commercialization. "The subset of inventions on which did not hold exclusive rights," Eisenberg shows, "were presumably those with the least commercial potential, and it is thus unsurprising that they were not heavily utilized commercially." Though the report did not firmly endorse an across-the-board license policy, it did suggest that "contractor-take-all" would better promote commercial utilization in certain circumstances.[lxxix]

The Nixon Administration would take the next step in implementing the report's recommendations. In a 1971 Presidential Memorandum and Policy Statement, Nixon further encouraged the transfer of patent rights to contractors by further clarifying and expanding the situations in which contractors could obtain exclusive licenses. The Memorandum also allowed government agencies to strategically grant exclusive licenses for patents that were formerly given a non-exclusive status, all with a view toward increasing the commercialization rate of government-funded inventions.[lxxx] The Memorandum was met with some controversy, but this time from consumer advocacy groups like Ralph Nader's Public Citizen and not from congressional progressives. Long had maintained his interest in reforming government patent policy, but he was now fighting a one-man battle. NAM's spirited defense in the early 1960s had paid off: the momentum had clearly shifted in the direction of contractor-take-all, a uniform government title policy seemed now a distant threat. Still, the pro-contractor approach remained on somewhat shaky ground, since it was based only on executive memoranda without formal congressional approval. As the next chapter discusses, NAM and allied groups would win the policy debate conclusively by the end of the 1970s, as landmark legislation would establish contractor-take-all as the favored policy across nearly all federal R&D agencies.

Conclusion: Patents and Planning Decoupled

As the size of the federal R&D budget reached historically unprecedented heights during the early Cold War and then the space race, new proposals emerged that sought to restructure the existing system along lines resembling Kilgore's vision from a generation earlier. A fundamental change had occurred during this new period, however: while both patent reform and planning were combined in Kilgore's proposals, a result of the historically specific convergence of New Deal planning and anti-monopolism, the newer rounds of reform proposals during the space age separated out these two institutional components. Ambitious new calls for a centralized and coordinated R&D system led by a Department of Science and Technology paid no attention to the patent controversy that had in part defined the earlier debate over the NSF. Similarly, populist attacks on the contractor-take-all system focused only on government patent policy and eschewed notions of planning. What had been in the 1940s a singular vision for a government-led and government-owned R&D system geared toward national technological goals was now deconstructed into its component features.

With the decoupling of patent reform from R&D planning came a marked evolution of NAM's positions. While NAM remained firmly committed to the contractor-take-all, fending off the Long's assault and lobbying for a further expansion of the license policy, the Association began to view R&D planning in a more favorable light, taking Humphrey's proposal into serious consideration and examining ways in which a more centralized R&D system might also be a more profitable one. It is difficult not to assume that NAM's successful defense of the prevailing patent policy was causally linked to its changed attitude toward planning. Beginning with Kilgore's proposals in the 1940s, the patent question had always been the primary reason for NAM's reluctance to embrace reform of the R&D system. With that question now essentially resolved in NAM's favor, the organization could now entertain the possibility that R&D planning might actually serve the interests of industrial capital.

The late 1970s and 1980s would bring another period of stark institutional change for federal innovation policy. The patent battle would conclude in NAM's favor with decisive legislation, and NAM would evolve even further toward a full embrace of R&D planning as a core component of a sweeping national industrial policy. Such a policy would never be adopted, however: amidst a radical rightward in American political economy more broadly, new capital growth machines would displace the R&D-oriented industrial firms in the political arena and a reenergized ideological Right would once again render the planning idea obsolete. NAM's embrace of R&D planning would be too little, too late.

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[i] As characterized in: Kleinman, Daniel Lee. *Politics on the Endless Frontier: Postwar Research Policy in the United States*. Duke Univ. Press, 1995.
[ii] *Id.* at 146.
[iii] Lesser, Jonathan A., and Mark P. Mills. "The Science Before the War." *Manhattan Institute*, 22 July 2020, www.manhattan-institute.org/the-science-before-the-war.
[iv] Kleinman at 147.
[v] Kevles, Daniel, *The Physicists: The History of a Scientific Community in Modern America*, Harvard University Press 1995; Kleinman at 149.
[vi] Hart, David M. *Forged Consensus: Science, Technology, and Economic Policy in the United States, 1921-1953*. Princeton University Press, 1998, at 174.
[vii] *Id.* at 175.
[viii] *Id.* at 201.
[ix] Weinberger, Sharon. *The Imagineers of War: the Untold Story of DARPA, the Pentagon Agency That Changed the World*. Vintage Books, a Division of Penguin Random House LLC, 2018, at 31.
[x] *Id.* at 33.
[xi] *Id.* at 34.
[xii] Brinkley, Douglas. *American Moonshot: John F. Kennedy and the Great Space Race*. HarperPerennial, 2020, at 129.
[xiii] *Id.* at 119.
[xiv] Weinberger at 39.
[xv] *Id.* 47-49.
[xvi] Westwick, Peter. *Stealth. The Secret Contest to Invent Invisible Aircraft*. Oxford University Press Inc, 2020.
[xvii] Brinkley at 159.
[xviii] *Avalon Project - Military-Industrial Complex Speech, Dwight D. Eisenhower, 1961*, avalon.law.yale.edu/20th_century/eisenhower001.asp.
[xix] Brinkley at 163.
[xx] McDougall, Walter A. *The Heavens and the Earth: a Political History of the Space Age*. American Council of Learned Societies, 2008.
[xxi] Brinkley at 193.
[xxii] Nelson, Richard R. *National Innovation Systems: a Comparative Analysis*. Oxford University Press, 1993, at 37, 41.
[xxiii] Gruber, Jonathan, and Simon Johnson. *Jump-Starting America: How Breakthrough Science Can Revive Economic Growth and the American Dream*. PublicAffairs, 2019, at 47.

[xxiv] Brinkley at 181.
[xxv] Johnson and Gruber at 49.
[xxvi] *Id.* at 50.
[xxvii] Minutes of Meeting of NAM Committee on Patents and Research, March 8th, 1950. Series 9 Box 154, NAM Collection, Hagley Library.
[xxviii] Minutes of Meeting of the Subcommittee on Research, NAM Committee on Patents and Research, April 26th, 1950. Series 9 Box 154, NAM Collection, Hagley Library.
[xxix] Series 9 Box 155, NAM Collection, Hagley Library.
[xxx] *Id.*
[xxxi] April 14th, 1959: News Clipping: “Major Budget Advance Tied to Non-Military Programs”, Series 9 Box 155, NAM Collection, Hagley Library.
[xxxii] Series 1 Box 24, NAM Collection, Hagley Library.
[xxxiii] Series 1 Box 105, NAM Collection, Hagley Library.
[xxxiv] Delton, Jennifer in Phillips-Fein, Kim. *Capital Gains*. Univ Of Pennsylvania Pre, 2016, at 190.
[xxxv] *Id.* at 186.
[xxxvi] *Id.* at 192.
[xxxvii] *Id.* at 190.
[xxxviii] Report of Subcommittee on Government Operations. Remarks by Dr. Wayne E. Kuhn of Texaco. Meeting of Research Committee. January 13, 1961. Series 9 Box 157. NAM Collection, Hagley Library.
[xxxix] Meeting of the Research Committee, October 7, 1960. 2020.300. NAM Collection, Hagley Library.
[xl] Weinberger at 57.
[xli] *Id.* at 174.
[xlii] *Id.* at 253.
[xliii] Meeting of the Research Committee, October 7, 1960. 2020.300. NAM Collection, Hagley Library.
[xliv] Minutes of Research Committee Meeting Oct 19, 1961. Series 9 Box 257. NAM Collection, Hagley Library.
[xlv] Nelson et al. at 50.
[xlvi] Graham, Otis L., *Toward a Planned Society*. Oxford Univ. Pr., 1976 at 98.
[xlvii] *Id.* at 113.
[xlviii] *Id.* at 120.
[xlix] *Id.* at 133.
[l] *Id.*
[li] Wang, Zuoyue. *In Sputnik's Shadow: the President's Science Advisory Committee and Cold War America*. Rutgers Univ. Press, 2009, at 3.
[lii] *Id.* at 50-52.
[liii] *Id.* at 87.
[liv] *Id.* at 55.
[lv] *Id.* at 56.
[lvi] *Id.*
[lvii] *Id.* at 159.
[lviii] *Id.* at 159.

[lix] June 5th, 1953: Minutes of Meeting of Government Cooperation Subcommittee, NAM Committee on Research. NAM Collection, Hagley Library.
[lx] May 1st, 1959: Minutes of NAM Committee on Research, NAM Collection, Hagley Library.
[lxi] *Id.*
[lxii] Minutes of NAM Committee on Research, May 1st, 1959. Box 156. NAM Collection, Hagley Library.
[lxiii] Minutes of NAM Research Committee, April 23rd, 1963. NAM Collection, Hagley Library.
[lxiv] Legislative IP Acts (LIPA) / History Archive: Patents, Copyrights, Trademarks, Trade Secrets; http://www.ipmall.info/sites/default/files/hosted_resources/lipa/patents/federico-commentary.asp#General_Description_of_Act
[lxv] Minutes of Meeting of NAM Committee on Patents and Research. June 14, 1950. 1411, 9, Box 154. 2020.297. NAM Collection, Hagley Library.
[lxvi] Minutes of Meeting of NAM Committee on Patents. October 18, 1951. 2020.297. NAM Collection, Hagley Library.
[lxvii] Remarks of William Neal, NAM Washington Office. February 6, 1952. Meeting of the NAM Committee on Patents. NAM Collection, Hagley Library.
[lxviii] October 21st, 1953: Minutes of Meeting of NAM Committee on Research, NAM Collection, Hagley Library.
[lxix] October 20th, 1954: Minutes of Meeting of NAM Committee on Research, NAM Collection, Hagley Library.
[lxx] Research Committee Minutes. September 11, 1962. Series 9 Box 257, NAM Collection, Hagley Library.
[lxxi] Remarks by William Neal, NAM Washington Office at meeting of the Committee on Patents. June 14, 1960. Series 9 Box 159. 2020.299. NAM Collection, Hagley Library.
[lxxii] Remarks by William S. Neal, NAM Washington Office at meeting of the Committee on Patents. March 11, 1958. Hagley Series 9 Box 159. 2020.299. NAM Collection, Hagley Library.
[lxxiii] Patent Policies of Departments and Agencies of the Federal Government, 1959: Hearings Before a Subcommittee, Eighty-sixth Congress, First Session, on the Effect of Federal Patent Policies on Competition, Monopoly, Economic Growth, and Small Business. December 8-10, 1959.

[lxxiv] Remarks by William S. Neal, NAM Washington Office at meeting of the Committee on Patents. June 14, 1960. Series 9 Box 159. 2020.299. NAM Collection, Hagley Library.
[lxxv] *Id.*
[lxxvi] Series 4, Box 29. NAM Collection, Hagley Library.
[lxxvii] “Washington Predictions” William S. Neal. NAM Washington Office. At meeting of the Committee on Patents. January 14, 1960. 1411 Series 9 Box 156. 2020.299. NAM Collection, Hagley Library.
[lxxviii] Eisenberg, Rebecca S. . "Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research." *Virginia Law Review* 82, no. 8 (1996): 1663-727. (Symposium: Regulating Medical Innovation.) at 1678.
[lxxix] *Id.* at 1680-1682.
[lxxx] *Id.*

Chapter 4:

Industrial Policy Wars:
Building the Hidden Developmental State in the Neoliberal Era

The 1980s ushered in a dramatic political shift in the US, one that would carry profound implications for federal innovation policy over the coming decades. The Reagan Revolution sought to sweep away the remaining vestiges of the New Deal Order and remake American political economy. The ascendent ideology of neoliberalism turned "Government" into the enemy, held up the market as the universal solution to the nation's economic and social ills, and touted the individual entrepreneur as the chief source of innovation and dynamism in the economy. After its very partial revival in the early-to-mid 1970s, the planning concept would face its most vehement attacks since before the 1930s, with the Hayekian critique of planning now elevated to conventional wisdom. Economic planning of any sort, including the capacity to coordinate and direct R&D at the federal level, would be all but decimated by the decade's end as it entered this newly hostile political terrain. It is a puzzle, then, that the Reagan Revolution also brought about yet another expansion of the federal research system. How did an epochal political realignment premised on the notion that the government had no productive role to play in innovation and growth coexist with a newly energized push to deepen the government's commitments to R&D, particularly in high-tech sectors?

In keeping with the analytical lens of the previous chapters, this chapter aims to resolve this puzzle through the lens of industrial capital interests and the various competing segments of the US business class. At the onset of the neoliberal turn, R&D-oriented industrial capital scored one of its most significant victories of the postwar era—the decisive triumph of "contractor-take-all" through congressional action. Eager to post political victories in the leadup to the 1980 election, congressional Democrats shepherded two bills that would cement patent transfers as an explicit aim of the federal R&D system. What was once tolerated as a means of getting private firms to participate in publicly funded programs was now lauded as a high-tech economic development scheme. Polarized debates over government patent policy that had raged in the 1940s and 1960s had yielded to the new consensus of "technology transfer."

With the battle over government patent policy now a relic of the past, industrial firms had little to worry about from the federal government's vast R&D system. As such, R&D planning came back to the fore, and NAM and other prominent voices in the industrial sector showed a renewed interest in government coordination of industry. NAM's new Technology Committee looked to Japan's Ministry of International Trade and Industry (MITI) with envy and lobbied for new forms of government-business collaboration. Eventually, the entire Association would put forward an industrial policy aiming to revive US industry in the face of Japanese competition and offshoring—NAM's most emphatic endorsement of industrial planning since it initially backed Roosevelt's National Industrial Recovery Act in 1933. A new debate over industrial policy erupted in policy and academic circles, with NAM emerging as perhaps the leading business voice in favor of increased coordination.

That debate was won in favor of tax and regulation cuts rather than an American-style MITI. Why was the industrial sector unable to secure an industrial policy, despite real enthusiasm for the idea among some of the sector's most powerful voices? As Fred Block has argued, the ideological weaponry of the New Right threatened all appeals for increased government coordination of the private sector, even those from historically anti-New Deal institutions like NAM.[i] But as this chapter will demonstrate, industrial capital had also lost much of its political clout by the start of the Reagan era, a result of deep transformations in the nation's economy that had taken root in the postwar era and come to full fruition by the late 1970s. The Reagan Revolution was not an industrial counteroffensive, but rather a new coalition of conservative capital interests that included, among others, finance capital, Sunbelt real estate, and, most significantly for R&D policy, high-tech entrepreneurial capital embodied in the newly ascendent Silicon Valley. With the role of the industrial sector in national policy making now diminished, a generalized national industrial policy that would have remade the federal R&D system was defeated. Instead, Reagan-backed "Cowboy Capitalists" won an incongruous mix of tax and regulation cuts along with one-off federal programs to promote specific high-tech subsectors. This new "hidden developmental state," in which the federal government's R&D programs are the unspoken source of the nation's capacity for innovation, would remain intact until the present.[ii]

I begin this chapter with an overview of the new economic and political environment in which NAM found itself in the late 1970s. I discuss how this new context reset the place of R&D in the economy and sent NAM and other policy voices searching for new alternatives. I then describe the most prominent alternative that emerged—an Americanized variety of the industrial policy of postwar Japan—and describe its implications for reform to the R&D system. Next, I discuss the leading impediments to the realization of this model in the US during this period: revived economic liberalism, and, more importantly, an ascendent business coalition of primary and tertiary sectors that threatened NAM's influence over national policy making. What follows is a detailed account of the debate over industrial policy during the Reagan years, in which I reconstruct NAM's own positions and ultimately fruitless efforts to influence that debate. The chapter concludes with an overview of the actual changes to the R&D system during this period.

The Great Slowdown

The 1970s produced an unfamiliar economic reality for most Americans. The postwar boom years had generated consistently high GDP growth rates, productivity improvements, and steady increases in the quality of life for the average American worker. By the end of the 1960s, the postwar economy was beginning to slow. Even before the Arab-Israeli War and OPEC oil embargo of 1973, unemployment and slowed growth were re-emerging in the US. The Bretton Woods system of fixed exchange rates backed by gold reserves had already been put under stress by liberalized international capital flows, and the fixed exchange rate system was abandoned in 1971. By the mid-1970s, a paradoxical combination of low growth rates and inflation—once thought impossible under the existing macroeconomic orthodoxy—had become the new normal. "Stagflation" sent economists and policy makers into a desperate search for new policy tools and theoretical paradigms. Three recessions punctuated the decade and incomplete recoveries left unemployment rates at levels unprecedented since before WWII. American capitalism's "Golden Age" had finally ended.[iii]

Beyond the macroeconomic measures, the trends that were now evident in the 1970s brought forth structural transformations in the American economy that would reshape the country for decades onward. With international trade expanding, manufactures now constituted a greater share of global cargo than ever before, accounting for 61 percent by 1973.[iv] The American manufacturing sector, however, contributed to a rapidly declining share of global trade. The economic recovery of Western Europe and East Asia, now nearly complete in its third decade, generated new competition for US industry on the world market. With tariff barriers lowered, American consumers were no longer limited to domestically-produced durables and were now buying German, Japanese, and Taiwanese goods. By the decade's end, 70 percent of the US market for manufactured goods faced a direct challenge from foreign competitors. Imports had overtaken domestically produced goods in consumer electronics, and in some cases had eliminated domestic production entirely: for example, by 1980 over 90 percent of domestic television purchases were foreign-made. In that same year the Japanese automotive industry edged out its American counterpart on the world market for the first time.[v] Subsectors that had once defined American industrial strength were now facing critical challenges amidst intensifying global competition.

Thus began a process of structural change that would erode the once-dominant position of large-scale American manufacturing firms in the national economy. Manufacturing workers had accounted for nearly 40 percent of the total workforce in 1960 but by the end of the 1970s were well below 30 percent. Of the 19 million new jobs created during the 1970s, only 5 percent were in the manufacturing sector, and jobs in the various service sectors now accounted for the overwhelming majority of employment growth.[vi] Industrial decline would also have sweeping effects on once-thriving manufacturing regions, with many of the steel and auto towns in the midwest and eastern corridor now hollowed out. Facing the prospect of a Chrysler bankruptcy and potentially 500,000 jobs lost, the federal government bailed out Chrysler in 1979, at that time the largest bailout of a single corporation in history.[vii] Many of those manufacturers that survived the immediate threat from foreign competition began to make the calculated choice to offshore much of their production in countries with lower labor costs. The entire structure of the large, vertically integrated and R&D-intensive manufacturer was thrown into question as the search for a return to postwar profit rates prompted dramatic internal reorganization.[viii]

What this meant for these manufacturers, which had up to that point been the drivers of the nation's private sector research effort, was that R&D no longer generated the returns that it had just a decade earlier. Competition with research-intensive foreign competitors meant faster product cycles and reduced opportunities for American firms to appropriate the returns to innovation.

Industrial R&D giants sought out lower-risk alternatives to capturing market share aside from actual improvements in products and processes, including a new reliance on branding and marketing. For those firms that maintained large-scale R&D efforts, the geographic fragmentation of operations—and most significantly, the physical separation of innovation from production—put new stress on the linear systems of technology development that these firms had relied on in the previous era.[ix] On the whole, the role of private R&D in the national economy began to shrink, with industrial R&D outlays decreasing by 15 percent from the mid-1960s to the mid-1970s. David Mowery and Nathan Rosenberg have summarized this situation as follows:

> Increasingly, firms were unable to justify investments in basic research and, in some cases, in R&D of all sorts. Combined with severe competitive pressures from foreign firms, increases in the inflation-adjusted cost of capital, and slowdown in the growth rate of the domestic economy in the 1970s, the returns to R&D investment may have declined during the mid-1970s, and the rate of growth in real industry expenditures on R&D plummeted. The role of industry as a performer of basic research declined, and many of the central research facilities of the giant corporations entered a period of budgetary austerity or cutbacks.[x]

The system of sustained US dominance in global markets, maintained at least in part by massive outlays for R&D by the government and private firms, had encountered a moment of deep crisis to which alternatives were sorely needed. In Western Europe, reformist and occasionally radical political movements proposed to deepen state control and regulation of the economy through neo-corporatist strategies. Socialist and even communist parties amassed new power in Italy, Portugal, Spain, France, and the UK, and retained influence in Scandinavia.[xi] However, the proposals actually pursued by these parties rarely went beyond traditional social democratic solutions, and the radical wings of these parties that were intent on planning and socialized ownership were generally subdued. In the UK, the "Red Labour" wing led by Tony Benn advocated for worker-centered planning and large increases in state ownership but were outmaneuvered by Labour leaders sympathetic to liberalized alternatives. In perhaps the most radical proposal ever seriously considered in a developed country, the Swedish Social Democratic Party devised a plan to gradually transfer all privately owned shares of large companies to worker-owned funds, but the Party soon after suffered electoral losses and had to scale back its ambition.[xii]

The US had no political equivalent to these labor-based parties in Western Europe, and reformist thinkers accommodated their own alternatives to the realities of the Democratic Party. Still, as noted in the previous chapter, there did emerge a surprising resurgence of the liberal regulatory impulse in the early 1970s, resulting in major victories at the national level for advocates of environmental protection, workplace safety regulation, and consumer protection.[xiii] By the decade's end, however, stagflation had made it painfully clear that the Keynesian solution would no longer suffice as a universal remedy to the country's economic problems. Embattled liberals looked for new answers to slow growth and unemployment, and eventually came to embrace—though, as will be discussed below, somewhat half-heartedly—a revival of sectoral planning and institutionalism that had once been the hallmark of New Deal reformism. This revival would include a renewed focus on the federal R&D system and its central role in driving American economic growth. Though they would sometimes model their ideas openly on some of the achievements of New Deal planning—in particular the Reconstruction Finance Corporation, National Industrial Recovery Act, and Tennessee Valley Authority—many of these newly converted advocates of planning drew more inspiration from abroad. The resurrected planning impulse now bore the name "industrial policy," and its promoters primarily looked not to the halcyon days of New Deal planning for inspiration, but to the high-tech industrial giant of the East.

The Japanese Miracle

Japan's unique path to industrialization—and, eventually, to the global high-tech frontier––was forged through a complicated process of institutional trial and error. In striking similarity to the pro-business associationalism promoted by Hoover and his administration, Japanese economic planners in the 1920s experimented with a system of "self control," in which the government would allow businesses to form cartels to regulate competition. This proved ineffective, as the powerful Japanese business groups refused to curtail production in the pursuit of a more harmonized economy. Equally ineffective—and far more destructive—was the Japanese wartime strategy of "state control" in which the Japanese state intervened into firm operations to such a degree that the daily management of firms was essentially placed under government mandate. The end of the Imperial era brought about something of a synthesis of these two forms of coordination: Japanese industrial policy required a high-capacity planning state to set sectoral targets, while leaving managerial operations in the hands of the *zaibatsu*, the powerful business conglomerates that emerged after the war. Critical decisions were placed under the purview of a single powerful agency, the Ministry of International Trade and Industry (MITI), created in 1949.[xiv]

MITI operated as a planning agency that identified priority industries and "nurtured" those industries in the service of a long-term national plan. The agency employed a wide array of policy tools, including selective tax breaks, land grants, and foreign technology licenses. This process involved dynamic corporatist arrangements in which MITI would regularly consult with business leaders and preside over cooperative business councils between competitive firms. As Japanese firms climbed the ladder of productivity and technological sophistication, R&D interventions took on an increasingly prominent role in MITI's strategy. The Ministry and its closely affiliated Science and Technology Agency managed a number of state-owned laboratories and industrial research centers, and set national priorities for government-supported as well as private R&D.[xv]

MITI also controlled national patent policy during the country's catching-up period, and often used its powers to reduce the enforcement period for patents or to lower royalties owed to their owners––though the ownership of patents generally remained with the *zaibatsu* themselves.[xvi] With respect to R&D, therefore, MITI actually developed the kind of powerful technology planning capacities imagined by certain American policy makers stretching back to Kilgore: a centralized agency that would manage nearly all of the nation's public R&D resources, all in the furtherance of a coherent national technology development plan.

The success of Japanese industrial policy depended on a close and cooperative relationship between the state and the national industrial capitalist class: MITI had to reserve a great deal of power to itself while still trusting industrial capital interests to behave in accordance with national plans. The economic bureaucracy thus needed a degree of authoritative—yet not total—influence over industrial capital. The Second World War provided the critical juncture at which this became possible, with its leveling effect on income and wealth throughout the country and destruction of many of the most powerful industrialist factions in the armament sector. The *zaibatsu* that managed to survive the war, including industrial giants like Mitsubishi, likewise saw their own political influence greatly reduced from the pre-war situation. The postwar reconstruction effort gave MITI its political legitimacy and ensured that its operations would be insulated from the vagaries of political shifts. In his retelling of the "Japanese Miracle" and the role played by MITI in delivering it, Chalmers Johnson suggests that on matters of economic policy during this period, Japan was only nominally a political democracy. While elected politicians "reigned" in the public eye, it was MITI itself that "ruled" the country and set the policy that actually determined Japan's economic path. Johnson argues that this required a sustained mobilization of intensified economic nationalism after the country's defeat in WWII. Japan during this period was a "quasirevolutionary" society with economic and technological development itself serving as the outlet for nationalist fervor. Such a state was *developmental*, in that the chief priority of the state was the development of the economy through pro-growth industrial planning.[xvii]

Japan thus mastered the strategy of "concentrate and control" envisioned by the American institutionalists of a previous generation. Johnson identified four key ingredients for Japan's developmental success: (1) sectoral planning and structural interventions in the economy; (2) political insularity of the planning apparatus itself; (3) political legitimacy of the national development project; and (4) a powerful central agency to devise and implement plans.[xviii] With the possible exception of political insularity, these were the basic commitments of the early New Deal planners who dreamed of a more coordinated American economy but could never overcome business opposition to achieving it. The Japanese model proved enormously successful: the 15-year period starting in the mid-1950s delivered a stunning recovery, with GDP growth rates frequently topping 10%. Japanese production had climbed the ladder of complexity and technological sophistication, graduating from basic manufactures to automobiles to complex electronics. In less than one generation, Japan had been transformed from an industrialized economy dilapidated by the war's destruction to the most technologically advanced nation in the world.[xix]

This pattern of breakneck economic development—unprecedented up to that point in the capitalist world—would be later repeated by other East Asian industrializers. Perhaps even more so that in Japan, the South Korean state directly intervened at the firm level to increase productivity and create "national champions" capable of competing with the most productive firms in the global market. In Alice Amsden's account, General Park's dictatorship became the "disciplinarian" of firms in sectors that it sought to promote, dealing out subsidies and rents conditional on stepwise improvements in productivity. If firms failed to perform at desired levels, they would have their subsidies withdrawn. Such intrusive interventions were only possible through political subjugation of the *chaebols*, the industrial groups that the state relied upon to carry out its plans.[xx] Robert Wade identified similar, though perhaps slightly less "cold-blooded," behavior on the part of the Taiwanese state, which nurtured industrial firms through a set of subsidies and penalties. Even more so than South Korea, the Taiwanese catch-up process relied on the strategic use of state-directed R&D as a means of upgrading national firms into increasingly high-tech markets. Collaborative R&D efforts, in which the state would cartelize a set of firms and encourage knowledge sharing, helped ensure Taiwanese entry into consumer electronics markets by the end of the 1980s.[xxi]

Though it was already well underway by the early 1960s, the Japanese Miracle caught the attention of American observers beginning in the mid-1970s. At that point, Japan's economic strength had become a growing source of fascination among American business leaders and a growing cause for concern in policy circles. Japanese management methods emphasizing continuous improvements by workers at each stage of the production process quickly became the envy of American auto companies. Pioneered by Toyota, this method of "lean" manufacturing sought to minimize active inventory and waste while maintaining productivity enhancements. The eventual export of these techniques across the world would transform nearly all manufacturing subsectors.[xxii] But beyond its newfound dominance in automotives, the most visible sign of the success of "Japan Inc." was the country's overtaking of American competition in high-tech and electronics. In just over one decade, the Japanese semiconductor industry had emerged as the leading rival to one of the US' staple high-tech industries. Japanese success in semiconductors owed much to state-backed collaborative R&D programs, in which competitive firms would enter into cooperative consortia to share intellectual property and production techniques.[xxiii]

For many observers, then, saving American industrial and high-tech firms—and in doing so, staving off even further national economic decline—would require the US to beat Japan at its own game. Competing with a high-tech national competitor with an industrial policy at the core of its growth machine left the US with no choice but to adopt an industrial policy of its own. This industrial policy would have to take stock of the federal government's vast R&D efforts and redirect them in the service of a national technology plan. This would ultimately be the position of NAM and other leading voices in American industrial business, and would become a priority for a set of prominent liberals in the Democratic Party. The 1980s, however, would not turn out to be a liberal decade.[xxiv] An ideological movement once relegated to the fringes of American politics during the New Deal era was quickly gaining momentum at the national level. This movement, along with the set of national economic interests that initially propped it up, would eventually discard visions for Japanese-style industrial planning in the US and inaugurate a radical shift in the opposite direction.

Men of the Market

Even the most astute observers of the 1970s failed to anticipate the revolution at the nation's doorstep. The national political culture was obviously polarized, but it seemed to many analysts that the decade was gradually producing a more realistic, self-critical America that might better understand its collective shortcomings and failures to live up to its promises. In his history of the mid-1970s, Rick Perlstein describes a creeping pessimism in the national culture, a result of fallout from the Vietnam War and economic malaise now in full swing.[xxv] Still, the liberal advances in key terrains of cultural struggle from the previous decade, including racial equality, women's rights, and sexual freedoms, seemed reasonably secure. In the 1970s, however, backlash movements against each of these advances—often local in character and thus given less national attention—began to mobilize even larger constituencies to oppose policies like school busing, the Equal Rights Amendment, and abortion. Of all these reactionary single-issue movements, however, the most successful was the tax- and regulation-cutting crusade beginning with Proposition 13 in California and now sweeping much of the country. This movement made an enemy of the core elements of New Deal liberalism: high taxes, regulation in the public interest, and compensatory fiscal spending. Still considered a fringe candidate as late as 1976, Reagan was swept into the White House four years later with the promise of "Morning in America."[xxvi]

Neoliberalism inaugurated transformations in myriad aspects of cultural and political life, first in the US and UK and eventually across the developed world. Reagan combined reactionary neo-populism with a revival of Cold War nationalism. The ethic of individualism, always central to American life, was now elevated to the singular cultural theme of the nation. Perhaps most of all, though, the "Reagan Revolution" offered an economic theory and a clear alternative to the embedded liberalism of the New Deal state. Broadly, this was a revival of 19th Century economic liberalism (hence *neo*liberalism) that sought to restrict the role of the state to facilitator of the market and guarantor of private property rights. Government intervention in all other forms—including regulatory, redistributive, and especially planning capacities—became anathema to the unquestioned goals of growth and prosperity through free market policies. This was therefore the clear counterpart to the rising tide of liberal and leftist interventionism across much of the developed world in the 1970s.[xxvii] Rather than deepen the commitments of the modern state in regulating and directing the economy to combat stagflation, neoliberalism proposed a dramatic scaling back of the state in an attempt to free up capital and open new opportunities for profitable investment. Reagan laid bare this vision in his inaugural address: "In the present crisis, government is not the solution to our problem; government *is* the problem."[xxviii]

The ascendent ideology of the New Right created an environment more hostile to the planning concept than had ever existed in the modern era. Even more so than redistribution or regulation, planning represented the cardinal vice of modern governments according to the leading proponents of neoliberal economic theory. Reactionary attacks on planning during the New Deal had mostly offered only vague appeals to the American national tradition of "free enterprise"—itself a more recent notion than its promoters would admit. For these critics, the government should not plan the economy because it simply had not done so before. With the rise of neoliberalism and the renewal of attacks against New Deal institutions came a new and more sophisticated critique of planning that went beyond appeals to history and nationalism. Effective planning became a theoretical impossibility; at best a waste of valuable resources, at worst a step toward tyranny.

The leading advocate of this now dominant critique of planning was Friedrich Hayek, likely the most influential figure in neoliberal thought. Beginning in the 1930s, Hayek developed a broad body of economic and social theory that aimed to combat efforts of liberal and socialist reformers to place the economy under increased governmental control. With respect to the planning debate, Hayek's point of departure was in his initial conception of what the economy was and how it could be understood. Economic activity in the modern economy was simply unknowable, a result of both the complexity of that activity in modern markets and the pre-rational nature of much of economic exchange. The economy was a mysterious system that the machinery of the state could never comprehend well enough to intervene effectively. Instead, the price system represented the only available means of aggregating the infinite decentralized pieces of information into signals that could facilitate rational economic activity. The advent of advanced calculation tools—including computers and the use of cybernetics—made little difference, since under Hayek's model information can only be communicated at the point of exchange and cannot therefore be predicted upstream in the production process.[xxix]

Planning could therefore only be used for corrupt ends. Hayek and his followers, who came to include some of the most influential economists and policy makers in the Western world, concluded that failed attempts at economic planning would inevitably devolve into pure rent-seeking behavior. Planning, along with less intrusive forms of regulation and redistribution, would come to serve only "special interests" that were best positioned to capture the state for their own ends. This critique also extended to the kind of planning practiced by states during periods of economic catch-up, including Japan. Neoliberal development economists attacked the conception of the state as an actor that could effectively solve coordination problems in development and carry out plans for the public interest. Instead, the state was, according to a prominent set of critics, fundamentally a rent-seeker that would tend to disrupt the normal workings of the market, which, if left alone, would allocate resources efficiently and generate long-term growth.[xxx] With respect to industrial policy, therefore, neoliberals tended toward denialism. These critics interpreted Japanese success as a result of trade openness and export-oriented policies, and assumed that this success was attained in spite of the state's intervention and not as a result of it.[xxxi]

What is particularly striking is that the ideological shift toward neoliberalism, despite its obvious links to the growing business counteroffensive, sought to dampen enthusiasm for economic planning in all its forms—even those that were favorable for business. As the previous chapters have tried to make clear, the American planning tradition spanning back to the early days of the New Deal was never straightforwardly "anti-business." Indeed, some of the major planning experiments of the New Deal garnered, for a time, the enthusiastic support of business leadership.

NAM and other major business groups had demonstrated a pragmatic stance toward planning, recognizing that under certain circumstances increased government coordination could avoid overcompetition and yield higher profits. The rise of neoliberalism as the dominant ideological force in American politics eliminated such nuance. Much of the New Right's ideological power derived from the simplicity of its message—that government intervention in nearly all forms was counterproductive or outright harmful. This left no space for the possibility that the state could be utilized as a tool for organizing the economy along pro-capitalist lines, as Japan had so dramatically demonstrated. Had American industrial capital changed its position on planning? On the contrary, NAM and industrial leadership were actually closer to embracing planning than at any point since 1933. Rather, the leading business interests behind the Reagan Revolution were those for which industrial and R&D planning could serve little purpose.

Sunbelt Barons and DARPA-funded Libertarians

The postwar boom reshaped the American business landscape and ultimately reconfigured its leading power centers. Immediately after WWII, as Chapter 2 suggested, the "Eastern Establishment" of Fordist mass production firms formed the backbone of the national economy and exerted a dominant influence over policy. Taking the lead from the Committee for Economic Development, NAM and other industrial business leadership moderated on key issues and largely accommodated themselves to the modern state institutions of the New Deal order, including the government's new role in promoting R&D. With the addition of R&D-intensive military contractors in the postwar period, industrial leadership became even more closely linked to the science state and welcomed its dramatic Cold War expansion.

All this time, however, the ground was shifting within national business leadership. The nation's rapid economic development was giving rise to new fortunes based in the South and the

Sunbelt, the fastest-expanding regional growth centers of the country, spurred on by suburbanization and internal migration. New capital formations in these regions had little in common with the now "traditional" manufacturing bases of the East and Midwest. Unlike the large-scale R&D-intensive manufacturers, these new "Cowboy Capitalists" presided over non-union, single-family-owned, and labor-intensive and extractivist forms of production. Dramatic growth outside the core postwar regions and industries continued during the slowdown of the 1970s, accelerated by government spending during the Vietnam War and by capital flight to the Sunbelt during the decade's recessions. In his analysis of the origins of Reaganism within the national business class, Mike Davis notes the political significance of the Southern and Sunbelt boom:

> The broadening of the New Right's organizational base was accompanied by a consolidation of its links with the new peripheral fraction of predominantly Southern and Western capital. The original nucleus of Sunbelt entrepreneurs who had financed Goldwater were reinforced in the late sixties and early seventies by new levies of Texas oil millionaires, Florida real-estate speculators and California construction contractors...The seventies witnessed the most rapid and large-scale shift in economic power in American history.[xxxii]

A host of sectors that were once fringe elements of the national business class thus came to occupy central roles. Reagan's coalition of primary (oil, minerals, and agribusiness) and tertiary (construction, real estate, and retail) interests were relatively unaffected by the inflation-driven rise of fixed capital and R&D investments, since they tended to engage in very little R&D to speak of, and were thus a safer outlet for rising financialization during this period. This "alliance of entrepreneurial rather than corporate capitalists," in Davis' characterization, thus had minimal connections to federal R&D programs or any other state operations aimed at supporting industrial development.[xxxiii] The revival of R&D planning in the shadow of Japanese competition and the coming debate over industrial policy bore little relation to the new entrepreneurial push to open up new opportunities for investment through tax and regulation cuts. With R&D-based investment having lost ground to these primary and tertiary forms, capital had fled the "Endless Frontier" and returned to the actual frontier.

Though this core set of business interests made no demands on state-based R&D programs, two of the more marginal factions of the Reagan coalition had closer links to the science state. For each, the new neoliberal political settlement promised expanded outlays of federal resources without the need to reorganize the federal R&D system in the direction of a central planning mechanism. The first of these were the set of research-intensive military contractors that had witnessed a federal spending renaissance during the space race and Vietnam War but now faced painful rollbacks in military spending during the 1970s. For these firms, neoliberalism's revival of anti-communist nationalism promised a return to the military budgets of the 1960s. Reagan would deliver even more, presiding over a defense surge of over 8 percent growth per year during his first term, a then-unprecedented increase during peacetime. By 1983, the defense budget was larger than it had been during the peak year of the Vietnam War. Reagan's first four years would see more military spending than any consecutive fours years of either the Vietnam or Korean War.[xxxiv]

The military spending surge, along with Reagan's big ticket promises of technological breakthroughs like the "Star Wars" missile defense system, ushered in a new heyday for leading R&D contractors. Boeing, Lockheed, Raytheon and others saw a dramatic increase in government contracts, which were paying out at much higher rates than in the pre-Reagan years. A 1984 Navy Department audit of the military-industrial system revealed that many of these contractors had seen a surge in profit from on the government-facing part of their businesses. In that year Boeing, for example, could count 94 percent of its profits from sales to the government, even though its civilian business accounted for the majority of its total sales. Raytheon reported similar figures, with 79 percent of profits from government contracts. Lockheed, now the nation's largest military-industrial contractor, had transitioned to a business model almost entirely dependent on government contracts, and made 85 percent of its sales—and 95 percent of its profit—through government contracts.[xxxv] Aerospace R&D thus benefited immensely from neoliberalism's promise of remilitarization.

A second and newer element of R&D-intensive capital also found a convenient vehicle in the Reagan Revolution. From its origins in WWII computing and telecommunications research, the new tech economy based in Silicon Valley had always been deeply intertwined with the government's R&D system. California was the largest wartime recipient of R&D funding, and Stanford's comparative advantages in ICT research made it a key catalyst in spurring the emerging high-tech ecosystem after the war. Government-backed projects, including the ARPANET and the satellite system, had birthed entire subfields of the tech industry. Despite these obvious connections to direct government intervention, however, Silicon Valley's leading entrepreneurs espoused hardline libertarian views from the start. Hewlett Packard (HP), the region's original powerhouse electronics firm, cultivated a new management style and organizational structure that would spread throughout the Valley, emphasizing the need to remain independent from bureaucratic oversight. Founder Dave Packard became the leading political voice of the region, and by the 1960s had pioneered the unique Silicon Valley mix of social tolerance and economic reaction. "Socialists in our government," Packard warned in a speech in 1963, "would place the importance of the state above the importance of the individual...They would direct our lives from Washington!" Johnson's revival of New Deal welfarism represented a new attempt to "put business under government monopoly."[xxxvi]

Silicon Valley's libertarianism reflected the new entrepreneurial business model that Packard and others had pioneered. In comparison with the rival Route 128 high-tech ecosystem, firms in the Valley were smaller and shorter-lived, with horizontal mergers and intellectual property sales functioning as the dominant source of growth. Almost all were non-union, and stock options given to employees at early stages became the preferred alternative to traditional industrial relations techniques. Perhaps most importantly though, the entrepreneurial cohort behind Silicon Valley were distant from the financial networks that had built and maintained the national manufacturing leaders on the opposite coast. West Coast startups were often founded by engineers without connections to establishment financiers and corporate managers, forcing these high-tech entrepreneurs to improvise a new system of corporate growth.[xxxvii] As AnnaLee Saxenian has illustrated in her comparative history of Silicon Valley and Route 128, it was this independence from the networks of Northeast and Midwest capital that led to a distinct West Coast business structure.[xxxviii]

Venture capital quickly became the lifeblood of this new structure and the dominant political issue for Silicon Valley's business leadership. By the late 1960s, a new push by progressive Democrats in Congress to increase the federal capital gains tax sent Valley leadership into a panic. Leading VCs like Ned Heizer lobbied Congress to roll back the recent tax hikes and accused policy makers of favoritism toward the incumbent manufacturing giants like General Motors.[xxxix] The dismal national economic performance of the 1970s offered a major political opportunity for West Coast VCs, who emphasized the Valley's excellent growth record and relished new narratives of a coming technological revolution that would resurrect the postwar boom conditions. Though this advocacy would eventually conquer both parties, Valley leaders found a more receptive audience initially on the Right. President Ford's Commerce Department released a study in 1976 celebrating "technical enterprises" and suggesting that high-tech entrepreneurial growth required more conducive investment rules. Sensing an opening, Valley lobbyists initiated a multi-year campaign that ultimately won them a major capital gains tax cut in 1978 against the protests of progressive Democrats and President Carter. The cut paid off enormously: in the first two years after the policy change, an additional $1.5 billion in venture investments flowed into the Valley.[xl]

This victory for venture capital thus had the effect of moving many of the Valley's most influential entrepreneurs closer to the orbit of Reagan and the New Right, whose promises of further tax cuts and a "decade of the entrepreneur" posed obvious advantages for the tech economy. Despite the overtures from a new group of "Atari Democrats"—a collection of young party leaders seeking to accommodate neoliberalism by embracing technology development as a leading economic policy—Silicon Valley had largely rallied to Reagan by 1980. That year, leading tech entrepreneurs and VCs formed a high-profile fundraising group that donated millions to Reagan's campaign. The Valley's lasting association with social liberalism proved to be no obstacle: neoliberalism's celebration of the individual and the freedom of choice easily accommodated what had once been a transgressive feature of 1960s radicalism. Margaret O'Mara characterizes the Valley's turn toward Reagan as follows:

> It really shouldn't have been much of a surprise. For all the hype around the countercultural personal-computer crowd, Silicon Valley remained in the hands of patriotic midcentury men who'd grown rich in the Cold War economy. The Midwest-born movie star who rode horses and cleared brush on his ranch became the perfect candidate for a group of California transplants and self-made millionaires who liked to think of themselves as cowboy capitalists. The tech industry's late-1970s adventures in Washington lobbying had only reinforced its conviction that government bureaucrats were bad for business, and deepened its faith in supply-side economics.[xli]

Silicon Valley entrepreneurialism thus became a significant though perhaps secondary element of the Reagan Revolution's new coalition. In combination with the dominant military contractors, the new captains of high-tech industry maintained a schizophrenic relationship with the federal R&D system—gladly accepting government funding and contracts in private, while extolling libertarian virtues in public. On the whole, this was a coalition of interests for which public R&D served a key purpose, but for which a revival of industrial and R&D planning would make little difference. Neoliberalism promised to deliver the combination of a weakened state with respect to regulatory and planning capacities and a dramatically expanded military state. For the economic interests leading the charge of the New Right, this signaled reliable opportunities for profit after a long downturn. For the nation's leading industrial interests, however, Reaganism offered very little beyond a crackdown on union strength. This fragmentation between the different elements of R&D-oriented capital, in combination with ascendent anti-statism and the new attack on planning, emerged just as the debate over whether the US should adopt an explicit industrial policy began to materialize.

An American MITI?

The debate over whether the US should adopt an explicit industrial policy emerged toward the end of the Carter Administration. Deep into the 1970s slowdown and with a reelection contest looming, Carter and his advisors were in dire need of alternative approaches to economic policy, having largely abandoned the traditional Democratic approach of countercyclical spending to maintain full employment. The Administration turned increasingly toward the supply side of the economy and, with the Japanese Miracle fresh in mind, began to consider new means of stimulating innovation and coordinating the industrial sector. In 1978 Carter announced the creation of a National Productivity Council (NPC), and in that same year initiated the tradition of an annual presidential report on innovation and technology. By late 1979 the Administration decided it needed a more forceful economic message to fend off a primary challenge from Ted Kennedy, who accused Carter of abandoning basic liberal commitments.[xlii]

Carter established his Economic Policy Group (EPG), which would engage in a year-long study of "industrial policy"—at this time, that term was used openly—to develop a plan for the revitalization of the economy and of American industry in particular. The EPG was a mix of high-level officials and cabinet members, and the research itself was delegated to a group of deputies and staffers, many of whom had become keenly aware of the Japanese model and believed it held promise for the American situation. Early records from the EPG suggest the staff had in mind ambitious reorganization plans and were not hesitant to endorse sectoral planning. EPG member and Assistant Secretary of Labor Arnold Packer actually flew to Japan to meet with MITI officials, and later urged the EPG to adopt an explicit policy of "creating winners" and "facilitating positive adjustment."[xliii] Science Advisor Frank Press was no less bold, suggesting that the federal government should mimic MITI's policy of choosing specific technologies to promote. Even the EPG's industrial policy skeptics acknowledged that the government already engaged in the promotion of certain industries by default and saw the need for a more conscious sectoral policy. The EPG's initial plan for institutional reorganization was to create a federal "Office of Industrial Development" modeled after Japan's MITI.[xliv]

In the final months of the EPG's study, however, the need to turn the group's research into concrete plans for Carter's reelection campaign put pressure on leading advisors to moderate. EPG leads George Eads and Jerry Jasinowski, who later served as the President of NAM during the late 1980s and early 1990s, translated the group's vast research notes into a three-pronged "revitalization plan" that Carter could promote on the campaign trail. The first two prongs were vague and implied no major institutional changes: the government would improve its capacity to collect information on the state of American industry, and would employ "cross-industry measures" such as tax and regulatory changes to encourage upgrading in a sectorally neutral manner.[xlv] The third prong, however, called for a "set of approaches" that would, in combination, represent a "full blown industrial policy." Eads and Jasinowksi were careful to point out the risks inherent to industrial policy, including political capture by certain sectors, but maintained that sectoral favoritism was "not...an approach totally unknown to the US."[xlvi] The EPG had taken clear inspiration from Japan during its research but now appealed to the Hamiltonian tradition in its public rollout of the plan.

Carter embraced the "revitalization" approach, though he chose not to use the term "industrial policy" in his announcement of the program. When pushed for more specifics by Kennedy, who had himself announced a "reindustrialization strategy" that included a new version of the New Deal's Reconstruction Finance Corporation, Carter's team translated their program into a series of new institutional proposals. These included a centralized Economic Revitalization Board that would promote "cooperation" between business, government, and labor, and a new "Industrial Development Authority" to match Kennedy's RFC. Carter's plan also emphasized that innovation would be a substantial focus of the Revitalization Board, which would be given broad powers to divert resources toward promising new areas of technology, including synthetic fuels and solar power. In his announcement, Carter pitched these new institutions as the start of a "journey toward a more productive and more competitive" American economy through an entirely new policy approach. Though it was never a full-throated endorsement of industrial policy, Carter's plan was still a decisive shift toward sectoral planning.[xlvii]

Reagan's landslide victory was an obvious setback for the inchoate industrial policy advocacy in DC and in academic circles. Ironically, many of these advocates became more convinced than ever in the early Reagan years that industrial policy was a winnable political alternative to neoliberalism, and a second and more public round of debate over the topic would soon commence. For the time being, however, Carter's industrial policy was stillborn. There remained only one surviving feature of the Administration's various investigations into industrial competitiveness and innovation: an emphasis on new means of promoting innovation through the patent system. This would again revive the issue of ownership of intellectual property originating in government R&D programs, and that debate that would now be concluded decisively.

The Triumph of "Technology Transfer"

The Carter Administration's study of technological innovation launched in the fall of 1978 and concluded a year later. The study was wide-ranging, and included analyses of trade, industry structure and competition, environmental and safety regulations, and, finally, a report on patent law and policy. This report noted the striking slowdown in American industrial innovation—as measured by capital investment rate and new patents issued—and compared the previous decade unfavorably to Japan. Policy recommendations ranged from a more capable federal patent office to new means of reducing the costs of patent litigation. The report's final proposal, titled "Transfer Commercial Rights to Government-Supported Research to Private," came down definitively in favor of the "contractor-take-all" position that had been still controversial just one decade earlier. Suggesting that "the Government...is not in a position to take advantage of its ownership of patents to promote enterprise," the report characterized the vast trove of government-owned patents as simply a wasted resource.[xlviii] In a nod to the 1968 Federal Council for Science and Technology statement, the report's critical assumption was that transfer to private contractors would improve utilization.[xlix] As for the common criticism levied by Kilgore and later Long that privatization of government-funded patents would force the public to "pay twice," the report countered as follows:

> If the results of federally sponsored R&D do not reach the consumer in the form of tangible benefits, the Government has not completed its job and has not been a good steward of the taxpayers' money...Such commercial utilization of the results of government-sponsored research would insure that the public would receive its benefits in the way of products and services, more jobs, more income, etc. The cost of government funding will be recovered from the taxes paid by the workers and their companies.[l]

The report thus cleverly expanded the concept of the government's "return" on its investment in particular technologies: though title would be transferred to private firms, the public did, in fact, collect a running royalty in the form of economic development itself. A second report released as part of the Administrations Committee on Industrial Innovation looked specifically at the relationship between private firms and federal R&D programs. The chairs of this second Subcommittee were representatives from Northrup Corporation and Xerox, and the other co-authors included high-level management from a number of R&D-intensive industrial firms, such as Lockheed, Goodyear, and Procter & Gamble. This report had very little to say about federal R&D programs themselves, aside from general observations on the significance of federal R&D support in spurring industrial development. Instead, the report's primary message was that the federal government should do more to encourage more collaboration between industry, university research, and federal laboratories. The barrier to further collaboration, as identified in the report, was the difficulty the private sector faced in trying to commercialize the results of their research partnerships. The chief means of achieving this were policies that could "increase the utilization of the results of university research by the industrial community thus stimulating the rate of industrial innovation," with the same strategy for industry-government partnerships.[li]

A new consensus was thus emerging that looked to "technology transfer"—a term more politically palatable than "contractor-take-all"—as a key mechanism for reviving American industrial growth in the context of the Japanese threat. This was some reflection of broader movements in intellectual property law in the US, which had been shifting increasingly in a pro-patent direction. The neo-Brandeisian critique of intellectual property—central to Kilgore and Long's argument in favor of government title—had waned over the previous decade. Progressive judicial hostility to patents had yielded to a new conservative legal movement that embraced the traditional justification for intellectual property and justified large-scale patent agglomerations on the basis of efficiency and consumer welfare.[lii] The courts were now boldly expanding the patent frontier, identifying new types of substances, products, and processes that could qualify as patentable material. This culminated in the Supreme Court's 1980 decision in *Diamond v. Chakrabarty*, which validated a patent filed by General Electric for a genetically engineered organism capable of breaking down crude oil in an industrial process. The old anti-patent tendency that had motivated Kilgore was thus defanged in the context of this new intellectual property renaissance.[liii] What remained was Long's complaint of a corporate "giveaway," which was lost in the neoliberal counter-argument that economic growth through technology development would represent the real return on the government's investment.

Following the Carter Commission's report, the new consensus on technology transfer resulted in two major pieces of federal legislation that sought to turn "contractor-take-all" from a controversial feature of the R&D system into an explicitly encouraged policy to induce industrial innovation. The first of these was the Stevenson-Wydler Technology Innovation Act, drafted in 1979 and signed into law just before Carter's electoral defeat. The new law required federal laboratories to actively seek out means of transferring intellectual property developed in-house over to private partners for purposes of commercialization. Federal laboratories now had to devote a predetermined percentage of their annual budget for technology transfer activities, and had to maintain technology transfer offices.[liv] The second law was more sweeping in scope and implicated the core debate over government patent policy. The Patent and Trademark Law Amendments Act, referred to now as the Bayh-Dole Act, provided the long-sought congressional approval of a blanket rule across nearly all federal R&D agencies that contractors should inherit patent rights from government-funded projects.

The Bayh-Dole Act originally applied only to universities and small businesses that partnered with the government on R&D projects. NAM representatives had lobbied for a universal policy for all R&D contractors during public hearings held by the Carter Commission, but were unable to broaden the bill's original scope. The exclusion of large firms from the original bill ensured bipartisan support and a swift passage through Congress. The hearings on the bill include only one voice of dissent: Russell Long, maintaining his position on government title that he first articulated in 1959, called it "the worst bill [he had] ever seen." Long recruited Hyman Rickover, founder of the Navy's nuclear submarine program and hero of the national innovation system, to deliver testimony against the bill and echo Long's critique that it would accelerate the corporate giveaway. Ultimately, Long abandoned his decades-long crusade. Realizing that the policy consensus had shifted clearly in the opposite direction, Long finally agreed to support the bill as a personal favor to Senator Birch Bayh, who had just been defeated in a reelection bid.[lv]

The scope of Bayh-Dole was expanded just three years after its original passage. In 1983, Reagan signed an executive order applying the law's uniform transfer policy to large contractors as well, which Congress reaffirmed in an amendment a year later. Large industrial firms now enjoyed equal status with universities and small businesses under the Act.[lvi] The extent to which

Bayh-Dole materially impacted existing government patent policy is questionable; after Kennedy's and Nixon's memoranda promoting a flexible approach to patent transfer, most large R&D contractors were already in a position to acquire government-funded patents even before the new Act. Recent scholarship suggests that despite the Act's reputation as a key pillar of the national innovation system, its actual impact on innovation rates and commercialization may have been minor.[lvii] But Bayh-Dole provided an important symbolic stamp of approval for the contractor-take-all approach, which had been mired in controversy for nearly four decades without formal Congressional endorsement. Its passage signaled a new era for federal innovation policy in which patent transfers would be explicitly encouraged.

NAM's Industrial Policy

Bayh-Dole had been a major victory for university research groups, small business, and, following the Reagan amendment, industrial giants. NAM's battles over government patent policy were now in the past, and the organization could turn its attention back toward issues of government coordination and industrial planning. As the previous chapter suggested, NAM had already moderated substantially toward R&D planning by the late 1960s. Concerns over industrial competition with Japan had pushed the organization even further by the early 1970s, putting the organization increasingly at odds with the economics of the New Right—at least with respect to sectoral planning. As part of an effort to "modernize" the organization, NAM had recombined its Patents and Research Committees back into a single group, now called the Technology Committee. Already in 1971, NAM's Technology Committee urged Congress to begin investigating reforms to the federal R&D system that would move it toward a more centralized system. Testifying before a House Subcommittee on Science and Technology during the period in which the Nixon

Administration was taking a serious look at R&D policy, the chairman of the Technology Committee offered the following:

> Until very recently, industry has been reluctant to enter into any type of partnership with government. However, a form of government-industrial partnership needs to be created to help take advantage of our technological gains and maintain a high level of domestic industrial activity...Government industrial cooperation in Japan is an economic strength that permits its technology to develop in a protected home market and to be advantageously exported as products and as technology. A similar program should be examined for the U.S.[lviii]

NAM was thus ahead of the curve on R&D planning, suggesting a shift in approach that anticipated the later industrial policy debates by several years. Concurrently with the emerging consensus on technology transfer in the late 1970s, NAM came closer to a full embrace of industrial policy near the end of the Carter Administration. After the release of Carter's "Domestic Policy Review," NAM wrote to the White House commending many features of the report, noting in particular its strong stance on a uniform pro-contractor patent policy.[lix] Additionally, NAM's response also included specific mention of Carter's proposed expansion of "Generic Technology Centers"—government-funded university or industry R&D facilities—which NAM characterized as a "valuable resource" that together may function "like operations of the Japanese Ministry of Trade and Industry."[lx] The major shortcoming of Carter's proposal was not its renewed commitment to federal sponsorship of R&D, but rather its failure to include tax and regulation cuts as leading goals.

Carter Advisor Jerry Jasinowksi, who had helped lead Carter's EPG and co-designed the "revitalization plan" in the leadup to the 1980 election, was brought into NAM a year later as Chief Economist. At a high-level meeting with the NAM board, Jasinowski asserted in a speech that "The source of our problems lies not with our ability to consume but our capacity to produce."

Jasinowski's alternative was "supply-side" policies that were geared specifically to the industrial sector, and he openly used the term "industrial policy" in his appeal. The new NAM President Alexander Trowbridge had been impressed by Jasinowksi's approach and believed the Association should put forward its own version of the Carter initiative. NAM's own six-point "Revitalization of American Industry" plan, released in April of 1981, drew heavily from the EPG's findings.[lxi] The plan included a number of reforms in line with Reaganist policies, including tax and spending cuts, but also included the broad category of "international competitiveness," which included a reorganization of the federal R&D system and a renewed commitment to industrial research in partnership with the government.

NAM's revitalization plan pointed specifically to the "decline of industrial innovation" as a major factor contributing to the loss of American manufacturing's competitiveness abroad.[lxii] According to Jasinowkski and his co-authors, this decline was due at least in part to "the lack of coordinated policies for cooperation between universities and the private sector," and what was needed was a more robust and rationalized federal R&D system.[lxiii] In a supporting policy working paper entitled "The Contribution of Science and Technology to the Revitalization of American Industry," NAM's Innovation, Technology and Science Policy Committee—the latest iteration of the Association's R&D-related policy committees—came to similar conclusions and lamented the lack of a "glamorous national program that would focus all of the nation's scientific and technological strengths."[lxiv]

Predictably, a closely related issue identified in NAM's revitalization plan was the patent system, and in particular "thousands of government-held patents [that] are unused."[lxv] The solution to this bottleneck was a "government-wide patent policy" that would "make it possible for any size firm to acquire exclusive license to government-held patents and restore the credibility of the patent system." This was NAM's call for the revision of Bayh-Dole noted above, which promptly expanded the Act's reach beyond universities and small businesses to large and already R&D-intensive firms. In his presentation of the revitalization plan to the NAM Board of Directors, Trowbridge noted R&D as a critical ingredient of the program and defended "R&D and other measures designed to enhance the competitiveness of our manufacturing industries" as a key point of concern for the organization. In typical fashion, NAM's release of its revitalization plan was bolstered by a public relations blitz, one that extended into late 1981 and included op-eds, television appearances by Trowbridge and Jasinowski, and a national conference with business leadership, academics, and policymakers.[lxvi]

Trowbridge and Jasinowski continued to push NAM toward a fuller embrace of the concept. By 1983, NAM had allied itself with the academic and policy thinker Robert Reich for a presentation of his recent work and discussion of various approaches to revitalization. As Otis Graham has recounted in his history of the industrial policy debate during this period, by this time Reich had become the most vocal liberal advocate of industrial policy in the country.[lxvii] Reich had just published his book *The Next American Frontier*, which offered an outline of a new American industrial policy that relied in part on a reworking of the federal R&D system. Reich believed the US already possessed an unspoken industrial policy embedded within its military R&D programs, which bore "a striking similarity" to "other nations' policies designed to accelerate the development of emerging industries," and which were already "promoting in the United States many of the same industries that are being promoted in Japan by the Ministry of International Trade and Industry (MITI)." Reich noted, however, that while MITI's R&D functions were geared explicitly toward moving Japan into new high-tech sectors and improving national competitiveness, the fragmented American equivalents "have failed to promote economic adjustment" by focusing excessively on legacy industries.[lxviii]

What set Reich apart from the other promoters of the "Japan Inc." approach for American revitalization was his explicit recognition of the link between the New Deal planning tradition and the approach to business-government collaboration mastered by Japan. While responding to calls to import Japanese-style institutions, Reich's book made numerous references to signature American industrial planning experiments like the NRA and TVA, and spoke highly of Roosevelt's planners. Graham offered this interpretation of Reich's book in the broader context of the history of national planning in the US:

> ...this was the language of the school of institutionalist economics, an intellectual tradition traced through the careers of Thorstein Veblen...Rexford Tugwell, John Kenneth Galbraith. Institutionalists shared a conviction that in the modern industrial economy markets were so imparied by the growth of large organizations––corporations, unions, multilayered government—that the rules of classical theory no longer applied…With industrial policy, institutionalism was coming home. Reich identified the problem as "the way the nation organizes itself for production" in the house of capitalism itself.[lxix]

NAM's association with Reich is therefore significant, and marks its furthest move back toward its pragmatic stance on industrial planning that it had maintained in the 1930s. There were, of course, limits to NAM's flexibility. Just as had been the case in Britain with Tony Benn and Red Labour's worker-centered industrial policy, there were more left-wing alternatives to the model Reich was advocating that were circulating in the US. The economist Samuel Bowles had advocated for an industrial plan relying on heavy regulation along with new experiments in union and community ownership of industry. For Bowles, the problems of low productivity could not be divorced from questions of ownership and their resulting management incentives. A strategy of cooperative ownership could realign the incentives of American manufacturing to keep jobs in the

US and reinvest in new technologies.[lxx] While Reich's model held great appeal for NAM, alternatives such as this were out of the question.

The debate over industrial policy eventually came to a head in 1983. By this time, industrial policy had become the answer to Reaganomics for a substantial number of leading Democrats, and presidential hopefuls like Walter Mondale had hired Reich as an economic advisor and focused a great deal on the concept during the Democratic primaries.[lxxi] Congressman John LaFalce, who had deemed industrial policy as "the leading issue for 1984," created a new House subcommittee to investigate the various proposals that had been put forward. Reich and other academic advocates of the concept testified before the hearings, and NAM also offered testimony in support of adopting a revitalization plan in keeping with the Jasinowski approach. The result of these hearings was a proposed "Industrial Competitiveness Act," H.R. 4361, which would have created a new federal R&D agency geared specifically toward industrial research. Though the bill had the rare support of both NAM and major labor groups, including the AFL-CIO, it came under immense ideological criticism from Reagan's political coalition and failed to get past initial stages, as discussed in the section below.

In response to the enthusiasm that was quickly building again, the Reagan Administration sought to appease the pro-revitalization corporate advocates in mid-1983 by creating a Presidential Commission on Industrial Competitiveness (PCIC) that would investigate the issue and formulate recommendations to the Administration. The PCIC was a small cohort of business leaders led by John Young, the CEO of Hewlett-Packard, and also included academics and labor representatives. After a year of research, the PCIC issued its report, *Global Competition: The New Reality*, which endorsed many of the ideas that had been percolating on the Democratic side since the end of the Carter years. Young had focused in particular on the fragmented nature of federal R&D policy. In a speech given in 1983 after being named chief of the PCIC, Young sought to cast fragmentation as a clear weakness in the R&D system:

> Federal efforts are scattered throughout several organizations and some 700 federal laboratories. Several recent studies...point to major administrative inefficiencies. By one count, there are some 2,700 distinct federal R&D program elements that receive line-by-line budget scrutiny from 54 congressional committees and subcommittees. That is a managerial maze that few scientists are equipped to navigate.[lxxii]

In its report, the PCIC recommended that the Reagan Administration create a new Department of Science and Technology—a striking revival of the 1958 Humphrey proposal.[lxxiii] The DST would absorb all of the existing civilian R&D activities spread out across the federal government, and would be tasked with setting "long-term national goals" and "coordinating the management of Federal science and technology policy."[lxxiv] A similar proposal was put forward for the centralization of trade policy: the PCIC recommended establishing a cabinet-level Department of Trade that would coordinate the various trade-related policies in accordance with national developmental goals. NAM offered an enthusiastic endorsement of the PCIC recommendations, and even published its own synthesis of the institutional reforms suggested in the report. Following the PCIC's recommendations, NAM proposed to combine the two new cabinets into a Department of International Trade and Industry (DITI), a clear nod to Japan's leading industrial policy agency.[lxxv]

The response from the Reagan Administration itself was, however, much cooler. Young and his colleagues presented the PCIC's recommendations to Reagan and his advisors at the White House and found little interest. The report nearly coincided with Reagan's decisive victory over Mondale, who anyway had basically abandoned industrial policy as a key element of his platform after winning the primary.[lxxvi] Young and former PCIC members extended their work beyond the one-off Commission and created the permanent private-sector Council on Competitiveness. In doing so, Young had the active support of NAM leadership and even used one of NAM's tax-exempt 501(c)(3) organizations to incorporate the new organization.[lxxvii]

The MITI Myth

By 1985, the industrial policy debate had ended. There would be no American MITI (or, in NAM's proposal, a DITI), and Reaganomics would dominate the federal approach to economic policy for the coming three decades. Though industrial policy advocates had some momentum in the early years of the decade, the neoliberal counter-attacks had triumphed by the time of Reagan's reelection, despite his Administration's gesture in creating the PCIC. The first rhetorical strategy of this opposition was to equate industrial policy with "planning" and its various New Deal associations. This was, of course, an accurate description and, to advocates like Reich, a link with the country's history that should have made the concept of industrial policy more palatable. As noted in the preceding discussions, however, "planning" was the cardinal sin for neoliberal ideological leaders, who associated the concept only with inefficiency, corruption, and authoritarianism.

This attack began with Reagan and his cabinet. The President quickly turned against LaFalce's Industrial Competitiveness Act as an attempt by "government planners" to "divert resources away from traditional industries and channel them into new fields." The proper role of government in facilitating economic growth, Reagan asserted, was "protecting and maintaining the marketplace."[lxxviii] Treasury Secretary Donald Regan said in a public statement that recent proposals from the opposition amounted to "20 or 30 Government planners acting collectively" compared with the Reagan Administration's strategy of "having economic allocation decisions made by 230 million Americans acting in the free marketplace."[lxxix] Beyond this ideological stance, the Administration also emphasized the difficulties in delivering such a policy. Reagan's Undersecretary of Commerce noted that the LaFalce's proposals were "simply impractical to implement," given the vast amount of information that the government would have to synthesize in order to carry out an effective industrial policy.[lxxx]

Conservative think-tanks offered more dire warnings. The Cato Institute, an increasingly influential libertarian think tank, echoed Hayek's *Road to Serfdom* by proclaiming that industrial policy would "put the US on the road to central economic planning." The Institute commissioned its own year-long study of the topic to match those launched by the EPG and later the PCIC. The Brookings Institute offered a similar line of attack while focusing more on practical limitations. A 1983 report from Brookings applied the Hayekian critique of planning to industrial policy proposals, seeking to invalidate the two critical assumptions behind these proposals—that the government had the sheer capacity to pick industries effectively, and that such a capacity could be free from the corrupt influence of special interests.[lxxxi] By the end of 1983, the counter-arguments against industrial policy had started to overwhelm its initial supporters. The Heritage Foundation celebrated that "intellectual support for the notion of an industrial policy is unraveling."[lxxxii] Paul Krugman noted the resilience of the market-based counterarguments during this period:

> Support for some kind of targeted industrial policy comes from a remarkably wide political spectrum. The idea is favored by nearly all Democrats and many Republicans, nearly all liberals and many conservatives, nearly all unions and many businesses. The only fairly unified opposition comes from professional economists. It is a tribute to the force of free-market ideology that we have resisted industrial targeting as long as we have.[lxxxiii]

In addition to its emphasis on theoretical and practical difficulties, the neoliberal attack against industrial policy also included a reinterpretation of economic history, both in the US and abroad. New Deal planning experiments, some of which indeed had contested interpretations, became unambiguous failures holding back economic recovery. The NRA, for example, was now treated by conservative critics as a corrupt experiment in "corporate welfare"; likewise for the RFC, which LaFalce and others sought to emulate with proposals for a new state-backed industrial bank.[lxxxiv] New Deal planning writ large was, in Reagan's telling, a "modified form of communism" that sought "government management" of the entire economy.[lxxxv] Reich's attempts to link the new industrial policy proposals with that tradition were thus highly controversial. As for Japan's industrial policy, a new conservative counterattack insisted that the "MITI Myth" could not be causally linked to rapid industrial development in Japan. The causal story was always difficult for "Japan Inc." promoters like Chalmers Johnson, who simply took for granted based on careful historical case studies that the actions taken by the economic bureaucracy had a positive impact on the country's development.[lxxxvi] MITI through the neoliberal lens was more likely a hindrance to economic growth, and Japan achieved its miracle in spite of the agency's attempts to engage in sectoral planning.

Despite its increased support for the concept, NAM was unable to push forward an agenda for a new industrial policy in the face of these attacks. The dawning neoliberal era had already delivered victories for which NAM had spent decades advocating. Union strength was declining rapidly, regulations were being slashed across the board, and the new approach to technology transfer had settled NAM's fight for a pro-business government patent policy. Somewhat paradoxically, the early Reagan years saw NAM's influence over national policy dramatically reduced from what it had been in the preceding decades. NAM historian Jennifer Delton describes the Association reaching a sudden "nadir," a result of increased influence of Reagan's new coalition of primary and tertiary sectors. NAM was now overshadowed in a newly diverse and fragmented landscape of pro-business lobbying, a considerable shift from the earlier moment of relative coherence among business leadership in the postwar era. The new state of fragmentation in American capital coincided with the triumph of the business counteroffensive, but this came at the cost of cross-industry consensus on certain policies.[lxxxvii] Delton has summarized the shifting landscape as follows:

> ...unlike in the 1970s, when business interests were unified and articulated...the new business business lobbyists were diffuse and varied...Moreover, the increasing variety of organizations was due to the competing interests among them. The policy objectives of the American Business Conference's high-tech companies and junk bond dealers were different from those of the Carleton Group or NAM. So while business was riding high during the Reagan administration, it was no longer as organized and taut, nor did it privilege the interests of manufacturing.[lxxxviii]

NAM's potential business allies in the industrial policy debate that were closer to the power center of the Reagan coalition were of no help. As noted above, Reagan's revival of the Cold War delivered massively for the leading military-industrial firms, which saw no need to install a new industrial planning mechanism in the federal government. With the notable exception of HP's John Young at the helm of the PCIC, Silicon Valley leaders largely maintained their focus on the capital gains tax and avoided any clear stances on the topic of revitalization. Valley leadership increasingly aligned with Congressman Ed Zschau, a promoter of venture capital and a leading critic of "backward looking" proposals like the EPG's and PCIC's.[lxxxix] NAM, once the dominant voice of industrial capital and leading business influence over the federal R&D system, now found itself isolated and ineffective on the industrial policy issue. By mid-decade the Association distanced itself from its advocacy efforts five years earlier. In early 1984, Jasinowski, formerly NAM's leading proponent of "revitalization," asserted that "the industrial policy proposals are dead," and that NAM would be "shifting to a broader range of policies that cut across industry lines and focus on our international competitiveness."[xc]

The New Hidden Developmentalism

Centralization and R&D planning had been taken off the table by the mid-1980s, but competitive threats abroad and sluggish industrial growth at home persisted. Innovation policy would be expanded, but the strategy eventually embraced over the course of the decade was one of further fragmentation—the antithesis of the approach called for by the decade's leading industrial policy advocates and by NAM. By the decade's end, the R&D system would increasingly rely on the "extended pipeline" model, in which the government played a much more active role in developing and commercializing new technologies than it had before. The R&D system would require more business-state collaborations, but all within increasingly specialized programs with narrow mandates. Proposals for broad initiatives, like those included in the Industrial Competitiveness Act, gave way to one-off, subsector-specific programs disconnected from any larger plan for technological development. This fragmented "hidden developmental state," as the preceding discussions have suggested, reflected NAM's reduced influence and the newly fragmented structure of R&D-oriented capital.

An illustrative example is the SEMATECH program, a 1986 initiative designed to rescue the ailing American semiconductor industry.[xci] The program relied on an industry consortium model that was newly permitted under a 1984 law that relaxed antitrust restrictions on pre-competitive R&D cartels. By the mid-1980s, the US semiconductor industry faced a serious threat from Japanese firms, which had by that time captured the bulk of global market share and improved the quality of their products beyond those of American firms.[xcii] In response, Intel, Texas Instruments, and twelve other large US-based semiconductor manufacturers formed an organization to lobby the federal government for a technical assistance program that would bring the industry back up to the global competitive frontier.[xciii] The result was a five-year, 500 million dollar federal program co-funded by DARPA that sought to increase the speed and quality of chipmaking by US firms. The consortium was considered a success, having quickly reduced the cost of research and development for new processes of chip production by over fifty percent. Many observers have suggested that SEMATECH played a key role in the return of US semiconductor firms to global leadership by the mid-1990s.[xciv]

Narrowly-tailored R&D programs flourished under Reagan. In 1984, the Administration established the Small Business Innovation Research (SBIR) program, an initiative to provide seed funding for startups primarily in the tech and pharmaceutical fields. DARPA launched a series of new field-specific programs, including the $1-billion Strategic Computing Initiative, the first government-led program for artificial intelligence research.[xcv] In 1988, the manufacturing industry welcomed the new Manufacturing Extension Partnership (MEP), though this was not an R&D program and was likewise narrowly tailored to the problems of small-to-medium sized manufacturing firms. At the decade's end, the Department of Energy announced The Human Genome Project, a joint effort with the NIH that invested over $100 million annually and led to breakthroughs in biotechnology and genomics research. Taken together, these new initiatives extended the reach of the federal government in technology development but did so in increasingly uncoordinated fashion. Fred Block has described this paradoxical result as follows:

> Taken together, these initiatives can be seen as efforts to build on the successes of ARPA and NIH in nurturing new industries. So despite public declarations that industrial policy was wrong because government should not try to pick winners, initiatives were taken that created a decentralized system through which public agencies would, in fact, invest in potential winners.[xcvi]

The short-lived exception to increased fragmentation of the federal innovation system was the creation of the Advanced Technology Program (ATP) in 1988. Originally a core feature of

LaFalce's 1983 industrial policy proposal, the ATP was a new R&D agency with an unusually broad mandate to support industrial technology development across many different sectors and at firms of all sizes. The program had the support of NAM, but failed to garner a broad enough constituency of the business class to protect it against the neoliberal attack on industrial policy, still hegemonic into the late 1980s and early 1990s.[xcvii] The ATP was never given sufficient funding to effectively test out its model and, and vocal calls for its elimination began in 1995. The program lingered on until it was cut in 2003, still having never fully gotten off the ground.

Meanwhile, despite abandoning the term "industrial policy," which by mid-decade had become synonymous with government overreach and inefficiency—much in the same way "planning" had some years earlier—NAM continued to advocate for a more coordinated R&D system as a means of advancing its economic goals. In 1988, NAM formed a new "Council on High Technology" to reexamine the Association's R&D policy positions looking toward the new decade. NAM's Council issued a new National Science Policy that emphasized R&D as a tool for achieving "long range national problems." In order to do so, NAM suggested that the R&D system in the 1990s must include "a coordinating mechanism to enable all the agencies and instruments of government...to make the best use of their resources and to coordinate their science and technology programs with a view toward meeting national needs and priorities." The new policy also included a greater emphasis on later-stage technologies, an endorsement of the new "extended pipeline," in which the federal government would play a larger role in development and commercialization of products than it had done in previous decades. NAM had thus accepted the paradoxical extension of the federal R&D system in the Reagan years but remained in favor of a more coordinated structure.[xcviii]

The 1980s saw a marked expansion of federal innovation policy along with a deepening of the institutional structure that had been built in the postwar era. A final push to centralize the government's myriad R&D programs and direct them in service of a national economic development plan, an idea that had first been articulated in 1943, lost out to further fragmentation and decentralization. While the 1960s had shined a light on state innovation programs to rally political support for the space race, federal R&D in the 1980s would be conducted in the shadows. The government's contributions to technological innovation would be an open secret in the neoliberal era. State R&D programs coexisted with free-market ideology by simply being ignored. The result of the 1980s industrial policy debates was thus a peculiar "hidden developmental state," in Block's terminology, a *de facto* high-tech industrial policy hampered by lack of coordination, unstable and unpredictable sources of funding, and intellectual property policies that favor the commoditization of publicly funded knowledge.[xcix] The federal R&D system was now an expansive network of business-state partnerships with very little democratic oversight, and one that guaranteed the private appropriation of the fruits of state-sponsored research. After decades of debates over these key institutional choices, Vannevar Bush's "Endless Frontier" had finally been realized.

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[i] Block, Fred. Swimming Against the Current: The Rise of a Hidden Developmental State in the United States. *Politics & Society*. 2008; 36(2): 169-206.
[ii] The term "Hidden Developmental State" was coined by Block, *infra* note 1, in his review of the expansion of federal R&D programs during the Reagan years.
[iii] On stagflation and the "long downturn": Blinder, Alan S. *Economic Policy and the Great Stagflation*. Academic Press, 1981; Brenner, Robert. *Economics of Global Turbulence*. Verso Books, 2005. On the political ramifications of the economic situation of the 1970s: Perlstein, Rick. *Reaganland: America's Right Turn, 1976-1980*. Simon and Schuster, 2020. 256-275.

[iv] Graham, Otis L. *Losing Time: Industrial Policy Debate*. Harvard U. P., 1994, at 9.
[v] *Id.* at 11.
[vi] *Id.* at 13.
[vii] *Id.* at 33.
[viii] For a recap of these structural changes in the manufacturing industry: Berger, Suzanne. *Making in America: From Innovation to Market*. MIT Press, 2015, 25-65.
[ix] Mowery, David C., and Nathan Rosenberg. *Technology and the Pursuit of Economic Growth*. Cambridge University Press, 1991, at 157; Berger *infra* note 8.
[x] *Id.* 158.
[xi] Harvey, David. *A Brief History of Neoliberalism*. Oxford University Press, 2003. 13-14.
[xii] Gowan, Peter and Mio Tastas Viktorsson, et al. "Revisiting the Meidner Plan." Jacobin, www.jacobinmag.com/2017/08/sweden-social-democracy-meidner-plan-capital.
[xiii] Harvey *infra* note 11 at 15.
[xiv] Johnson, Chalmers. *MITI and the Japanese Miracle: the Growth of Industrial Policy, 1925-1975*. Stanford University Press, 1982.
[xv] Kleinman, Daniel Lee. *Politics on the Endless Frontier: Postwar Research Policy in the United States*. Duke Univ. Press, 1995, at 166.
[xvi] Johnson *infra* note 16 at 17.
[xvii] Woo-Cumings, Meredith. *The Developmental State*. Cornell University Press, 1999, 1-32; Haggard, Stephan. *Developmental States*. Cambridge University Press, 2018.
[xviii] Johnson *infra* note 14.
[xix] Haggard *infra* note 17.
[xx] Amsden, Alice H. *Asia's next Giant: South Korea and Late Industrialization*. Oxford University Press, 1992; Vogel, Ezra and Kim Pyŏng-guk. *The Park Chung Hee Era: the Transformation of South Korea*. Harvard Univ. Press, 2013.
[xxi] Wade, Robert. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. Princeton University Press, 2004.
[xxii] For an extended discussion of lean manufacturing techniques in the auto industry and its broader implications for other sectors: Womack, James P., et al. *The Machine That Changed the World: How Japan's Secret Weapon in the Global Auto Wars Will Revolutionize Western History*. Harper Perennial, 1991.
[xxiii] Browning, Larry D., and Judy C. Shetler. *Sematech: Saving the U.S. Semiconductor Industry*. Texas A & M University Press, 2000, at 5-6.
[xxiv] "Liberal" in the usage of the liberalism of the Democratic party associated with state interventionism.
[xxv] Perlstein, Rick. *The Invisible Bridge: the Fall of Nixon and the Rise of Reagan*. Simon & Schuster, 2015. Introduction.
[xxvi] *Id*; Davis, Mike. *Prisoners of the American Dream: Politics and Economy in the History of the US Working Class*. Verso Books, 2018, at 157-181.
[xxvii] Harvey *infra* note 15.
[xxviii] Inaugural Address, 1981. The Ronald Reagan Presidential Foundation & Institute, www.reaganfoundation.org/ronald-reagan/reagan-quotes-speeches/inaugural-address-2/.
[xxix] Hayek, F. "The Use of Knowledge in Society." *American Economic Review*, 1945; On Hayek: Slobodian, Quinn. *Globalists: the End of Empire and the Birth of Neoliberalism*. Harvard University Press, 2020; Robin, Corey. *The Reactionary Mind*. Oxford University Press, 2013.

[xxx] Bhagwati, Jagdish N. "Directly Unproductive, Profit-Seeking (DUP) Activities." *Journal of Political Economy*, vol. 90, no. 5, 1982, pp. 988–1002; Krueger, Anne O. "The Political Economy of the Rent-Seeking Society." *The American Economic Review*, vol. 64, no. 3, 1974, pp. 291–303.
[xxxi] Nobel laureate Gary Becker famously said that "the best industrial policy is none at all." Quoted by Robert Wade in: Calcagno, Alfredo Fernando, et al. *Rethinking Development Strategies after the Financial Crisis*. United Nations, 2015.
[xxxii] Davis *infra* note 26 at 176-177. The preceding discussion likewise relies on Davis.
[xxxiii] *Id.* at 178.
[xxxiv] Fallows, James. "The Spend-Up." *The Atlantic*, Atlantic Media Company, 1 July 1986, www.theatlantic.com/magazine/archive/1986/07/the-spend-up/308325/.
[xxxv] *Id.*
[xxxvi] O'Mara, Margaret Pugh. *The Code: Silicon Valley and the Remaking of America*. Penguin Press, 2020, at 152.
[xxxvii] *Id.*
[xxxviii] Saxenian, AnnaLee. *Regional Advantage Culture and Competition in Silicon Valley and Route 128*. Harvard Univ. Press, 2000.
[xxxix] O'Mara *infra* note 36 at 161.
[xl] *Id.*
[xli] *Id.* at 195.
[xlii] Graham *infra* note 4.
[xliii] *Id.*
[xliv] *Id.*
[xlv] *Id.* at 41.
[xlvi] *Id.* at 42.
[xlvii] *Id.*
[xlviii] Advisory Committee on Industrial Innovation, Industrial Advisory Subcommittee on Patent and Information Policy, Report on Patent Policy (1979), reprinted in Advisory Committee on Industrial Innovation: Final Report, at 147.
[xlix] Eisenberg, Rebecca S. "Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research." Virginia Law Review 82, no. 8 (1996): 1663-727. (Symposium: Regulating Medical Innovation.) at 1689-1691.
[l] *Id.* at 156.
[li] Advisory Committee on Industrial Innovation: Final Report, Volume 1; Department of Commerce, 1979.
[lii] "A Brief History of the Patent Law of the United States." *Ladas & Parry LLP*, 25 Mar. 2016, ladas.com/education-center/a-brief-history-of-the-patent-law-of-the-united-states-2/#end.
[liii] 447 U.S. 303 (1980)
[liv] S.1250 - Stevenson Wydler Technology Innovation Act of 1980; 96th Congress (1979-1980). Discussed in Block, Fred L., and Matthew R. Keller. *State of Innovation: the U.S. Government's Role in Technology Development*. Routledge, 2016.
[lv] Recounted in: Mowery, David, et al. *Ivory Tower and Industrial Innovation University-Industry Technology Transfer Before and After the Bayh-Dole Act*. Stanford University Press, 2015.
[lvi] Eisenberg *infra* note 49 at 1695.
[lvii] Mowery et al. *infra* note 55.

[lviii] Testimony on Behalf of NAM by Dr. Willard M. Bright, "Science, Technology and the Economy" before the House of Representatives Subcommittee on Science and Technology, July 29th, 1971. Series 4 Box 27, NAM Collection, Hagley Library.
[lix] "Commentary of the National Association of Manufacturers on the President's Industrial Innovation Initiatives" 1411 Box 631, NAM Collection, Hagley Library.
[lx] *Id.*
[lxi] Delton, Jennifer A. *The Industrialists How the National Association of Manufacturers Shaped American Capitalism*. Princeton University Press, 2020, at 270.
[lxii] "Revitalization of American Industry," Acc 1411 Box 705, NAM materials, Hagley Library.
[lxiii] *Id.*
[lxiv] "The Contribution of Science and Technology to the Revitalization of American Industry and the Role of the NAM Innovation, Technology and Science Policy Committee in Formulating and Facilitating that Contribution." Acc 1411 Box 631, NAM materials, Hagley Library.
[lxv] *Id.* Box 705; Box 791, Folder 10. NAM materials, Hagley Library.
[lxvi] *Id.* "Communications Plan—Revitalization of American Industry"
[lxvii] Graham *infra* note 4 at 63.
[lxviii] Reich, Robert B. *The Next American Frontier*. Penguin Books, 1984, at 189-193.
[lxix] Graham at 65-66.
[lxx] Bowles, Samuel, et al. *Beyond the Wasteland: a Democratic Alternative to Economic Decline*. Verso, 1984.
[lxxi] Davis, *Prisoners of the American Dream*, at 299.
[lxxii] Young et al., "Global Competition: The New Reality," at 5.
https://www.freetradedoesntwork.com/research/Global_Competition_New_Reality.pdf
[lxxiii] *Id.* https://babel.hathitrust.org/cgi/pt?id=uiug.30112104104960&view=1up&seq=58
[lxxiv] *Id.* at 51.
[lxxv] Delton at 277.
[lxxvi] Hughes, Kent H. *Building the next American Century: the Past and Future of American Economic Competitiveness*. Johns Hopkins University Press, 2005, at 167.
[lxxvii] *Id.*
[lxxviii] Walsh, John. "Skirmish on the Industrial Policy Front." *Science*, American Association for the Advancement of Science, 29 June 1984.
[lxxix] Kenneth. "Regan Belittles the Idea Of U.S. Industrial Policy." *The New York Times*, The New York Times, 15 Oct. 1983, www.nytimes.com/1983/10/15/business/regan-belittles-the-idea-of-us-industrial-policy.html.
[lxxx] *Id.*
[lxxxi] Graham 119.
[lxxxii] Graham 144.
[lxxxiii] Krugman, Paul. "Industrial Change and Public Policy," 1983.
[lxxxiv] Graham 130-131.
[lxxxv] Lescaze, Lee. "Reagan Still Sure Some in New Deal Espoused Fascism." *The Washington Post*, WP Company, 24 Dec. 1981, www.washingtonpost.com/archive/politics/1981/12/24/reagan-still-sure-some-in-new-deal-espoused-fascism/928d80c5-3211-4217-85df-d775e1566c41/.
[lxxxvi] Haggard, Stephen, *Developmental States*, 2018.
[lxxxvii] As discussed in: Mizruchi, Mark S. *The Fracturing of the American Corporate Elite*. Harvard University Press, 2013.

[lxxxviii] Delton at 267.
[lxxxix] O'Mara 221-23.
[xc] Acc. 1411, Box 633, NAM Materials, Hagley Library.
[xci] For a detailed history of SEMATECH: see Browning, Larry D. and Judy C. Shetler, *Sematech: Saving the U.S. Semiconductor Industry*, 2000.
[xcii] Hof, Robert D., *Lessons from Sematech*, MIT Technology Review, July 25, 2011. https://www.technologyreview.com/s/424786/lessons-from-sematech/.
[xciii] *Id.*
[xciv] *Id.*
[xcv] Weinberger, Sharon. *The Imagineers of War: the Untold Story of DARPA, the Pentagon Agency That Changed the World*. Vintage Books, a Division of Penguin Random House LLC, 2018, at 280.
[xcvi] Block, 2008 at 179.
[xcvii] Negoita, Marian, "To Hide or Not to Hide? The Advanced Technology Program and the Future of US Civilian Technology Policy." *State of Innovation*, Eds. Block and Keller 2011, 85-103.
[xcviii] 1411 Box 828. Folder 22. NAM Collection, Hagley Library.
[xcix] Block (2008) at 194-196.

Conclusion:

The New R&D Politics:
Innovation Policy with Chinese Characteristics

This study has tracked the evolution of the federal R&D system from the New Deal era to the Reagan years, focusing on the key role of NAM in shaping the institutional structure of innovation policy as it underwent various reforms over the decades. I have argued that the two critical institutional choices in the structure of federal R&D—coordination vs. fragmentation, and government-ownership vs. "contractor-take-all"—were interlinked at pivotal moments of reform and led NAM to advocate against a more planned R&D system. Only when the battle over government-funded patents looked to be shifting decisively in NAM's favor, beginning in the 1960s and then unequivocally in the late 1970s, did NAM begin to advocate for more innovation planning. This was too little too late, however: NAM had lost its political dominance by the Reagan era and its calls for an R&D-intensive industrial policy fell on deaf ears.

The resolution of the 1980s industrial policy debate set the course of federal R&D politics for the ensuing decades. Despite a tentative revival of industrial planning ideas that included major reforms to the R&D system, federal policy firmly rejected a more robust, centralized, and coherent R&D planning system and instead embraced sector- and even technology-specific research programs. General-purpose R&D programs without already-developed corporate constituencies, such as the Advanced Technology Program, were axed by the neoliberal attack on government intervention and "corporate welfare." The hidden developmental state, however, managed to survive. Though budgets of the flagship federal research agencies—NSF, NIH, DARPA, NASA––have varied depending on the administration in power, they are clearly permanent features of the state and command support from key business and academic groups. The more narrowly targeted programs of the Reagan era, including SBIR, MEP, and others, have also been secure since their inception. Federal R&D programs have continued to play a dominant role in sustaining innovation-led economic development in the US, an irony of the neoliberal era that has survived a number of presidential administrations, none of which have seriously pursued reforms of the federal R&D system.

Since the rise of this "hidden developmentalism" at the neoliberal turn, a number of additions have been made to the vast array of R&D programs, each targeting a narrow technological field in the pattern set decades earlier and then solidified in the 1980s. The Clinton Administration, for example, leaned into the high-tech entrepreneurialism of the "Atari Democrats" from ten years earlier and campaigned for increased funding for DARPA, the ATP, and other programs. A decade later, the Bush Administration created ARPA-Energy, a green technology equivalent of DARPA situated within the Department of Energy, which the Obama Administration would endorse and expand in the immediate aftermath of the Great Recession. Like Clinton, Obama sought to make high-tech R&D intervention a key feature of his policy repertoire.[i] In addition to expanding ARPA-E, Obama initiated the Manufacturing USA program, a network of industrial R&D government-industry consortia spread out across various locations across the country. The Obama Administration also spearheaded new programs to fund green-technology startups, and in doing so, inadvertently revealed that the Reagan-era attack against "industrial policy" could still be recycled thirty years later. As part of its sprawling economic stimulus program, the Administration lent the solar startup Solyndra a $535 million guaranteed loan, only to see the company declare bankruptcy less than two years later. Republicans latched on to the story and deemed it yet another example of failed Democratic "corporate welfare" and government overreach. Solyndra became a minor scandal for the Obama Administration, even though the federal green startup loan program had turned an overall profit by 2014.[ii] Even in the aftermath of the Great Recession, the developmental state was still forced to hide.

The situation at the start of the 2020s may be very different, however. Recent years have witnessed a surprising revival of ideas about industrial policy and state-led innovation, and the anti-statist critique, still powerful under Obama, seems to have waned perceptibly. The federal R&D system has become a new focal point for a wide range of policy circles spanning the political spectrum, from China-fearing neoconservatives to progressive climate activists. "Industrial policy" is once again a buzzword, and in this iteration appears more secure from the reflexive conservative assault against all forms of government intervention. As I will show in this conclusory chapter, the renewed interest in industrial policy and in the federal R&D system as a key lever of economic policy has resulted from three distinct external pressures: (1) industrial competition with China; (2) secular stagnation and declining rates of productivity; and (3) climate change and its technological demands. China has dominated the conversation thus far, but the other two have also emerged as leading motivations. The response to each of these pressures has been some kind of broad reform to the federal R&D system, often in ways that would move the system closer to some form of R&D planning. Once again, Kilgore's intuition that a more centralized and coherent federal innovation policy would be desirable for certain ends has been revived.

I begin this conclusion with an overview of the three pressures noted above, and describe some of the implications for each of them. Ultimately, I suggest that the third pressure—technology development to aid in combating climate change—is likely to be the most practically feasible and politically workable in the years to come. I then discuss the new landscape of industrial and high-tech capital in the US as it relates to the political system, and I suggest that the type of advocacy and political influence wielded by NAM in the past eras discussed in this study are unlikely to appear again in the near-term, which may open up space for reform that did not previously exist. I suggest, however, that the institutional contradiction at the heart of R&D reform—that a more planned and government-directed R&D system might still hand over intellectual property rights to participating firms—is not likely to fade from view. If anything, the revival of neo-Brandeisian progressivism portends another revival of Kilgore and Long's critique of government patent policy, and there were already some murmurs of patent reform from Democratic candidates in the leadup to the 2020 election. Federal innovation policy may be more important than ever in the coming years, but the link between organizational structure and patent policy may continue to frustrate attempts at finally realizing a more planned innovation system.

The New Red Menace

In the four decades since Deng Xiaoping's pro-market reforms, the Chinese development experience has become the most significant economic event of our time. Evading the standard neoliberal development recipe of the "Washington Consensus," China has used a mix of classic industrial policy techniques along with a number of innovative market-based interventions to generate sustained growth rates that have completely transformed the nation and nearly surpassed the US as the world's largest economy. Technology, of course, has been a critical component of Chinese development strategy. From the beginning of the reform period, Chinese planners emphasized technology transfer as a key condition of foreign direct investment, and the country has made massive investments in R&D across a number of critical sectors.

The Chinese economy has thus steadily climbed the ladder of technological complexity and value-added production, moving from simple manufactures in the 80s and 90s to electronics and high-end industry in the 2000s. Today, China is poised for global leadership in the ICT sector, which has been a leading driver of American economic growth for decades. Even some of the US' critical industrial strengths such as aerospace appear to be under threat: Comac, the Chinese state-owned aerospace firm, has recently announced that it is ready to compete with Boeing on the global commercial aircraft market. Assuming this trend continues, the federal innovation system may be on the brink of a new period of reconsideration. With respect to the R&D system, China's rise has reproduced both the competitive anxieties of the "Japan Inc." debate of the 1980s as well as the Cold War arms race craze of the 1960s. We may therefore add a new row to the table presented in the introduction of this study:

Period	External shock	Dominant R&D capital formation	Reforms
1930s	Great Depression	Industrial	Consideration of R&D planning; no major reforms
1940s	WWII	Industrial	Creation of the NSF; maintenance of pluralist wartime R&D system
1950s/1960s	Soviet technological/military threat	Industrial, military-industrial	New leading agencies; increased fragmentation
1970s/1980s	Japanese competitive threat	Military-industrial, entrepreneurial	Technology transfer consensus; further decentralization
Current	Chinese competitive/military threat	?	?

In recent years, the US reaction to China's achievements in industrial innovation has become increasingly hostile. American critics now routinely accuse China of industrial espionage, claiming that Chinese firms—particularly those with links to important national developmental goals—violate the intellectual property rights of leading firms across the world.[iii] Accusations of economic espionage are particularly common from American policy makers, who have sought to cast doubt on China's capacity to actually innovate itself. The US Department of Justice has created a "China Initiative," a new investigatory body that focuses largely on IP theft by agents of China's Ministry of State Security and other technology-involved units of the CCP.[iv] Recent high-profile arrests of US-based scientists accused of hiding their links to Chinese research groups indicate a newly aggressive posture on the part of the federal government toward the exchange of scientific information.[v] These moves amount to a defensive strategy by federal lawmakers and institutions toward the growing technological rivalry. The emerging official line of the US government that China is threatening American high-tech dominance only through illicit means.

The flip side of this strategy is a new emphasis on US innovation. China's growing technological dominance has also prompted a rethink of American R&D policy, with a consensus emerging across the political spectrum that the federal government must recommit itself to supporting innovation. The competitive threat is significant enough to prompt even staunch conservatives to abandon elements of Reaganomic orthodoxy. One significant recent development was an extraordinary report released by the GOP-led Small Business Committee that advocated for a new industrial planning strategy and major new investments in R&D in order to combat the Chinese threat. In the introduction, Senator Marco Rubio, then-chair of the Committee, asserted that Chinese competition was the leading motivation for this rethink:

> High-end goods made by advanced manufacturing were the very products that America was supposed to make more of due to our competitive advantages in talent and capital. Instead, these products are increasingly being captured by China. The "Made in China 2025" industrial plan announced by the Chinese government makes their goal clear. China aims to become the global leader in innovation and manufacturing.[vi]

Strikingly, the report adopted a full-throated embrace of "industrial policy" and even "planning," suggesting that, in fact, the US has already been engaged in a *de facto* industrial policy for some time—an argument made by heterodox economists for years (and one upon which this study has relied). Whether the US intends to or not, the report asserted that some form of economic targeting is inevitable:

> ...the U.S. cannot escape or avoid decisions about industrial policy. States place great value on capturing high-productivity, high-labor content industries, or developing new ones. This is no new insight, for constraining the excessive possibilities of this behavior is arguably the orienting view of the World Trade Organization (WTO). States can attempt to redirect this fundamental interest by agreeing to "not select" industries, or at least not do so outside the bounds of reasonable policy difference. But even here, distinctions between competing decisions of economic value must be made.

To deal with the threat of China's "Made in China 2025" plan, the GOP's report advocated for a "corresponding response" that would carefully track which industries China is subsidizing and develop a plan to protect and boost the American counterpart. This would be achieved through a number of different measures, including a dramatic expansion of the federal R&D effort and the establishment of a new "Office of Critical Technologies," which would plan and implement a "whole-of-government approach" to "streamline efforts across the government to guard against threats to critical technologies."[vii] This would amount to technology development of a much more coordinated variety than what the US currently relies on.

A more ambitious proposal has emerged recently from the other side of the aisle. In mid-2020, Congressional Democrats revealed the "Endless Frontiers Act" (EFA), its name a clear homage to Vannevar Bush's famous 1945 tract. If passed, the EFA would dramatically expand and restructure the NSF, which would be renamed the National Science and Technology Foundation. In addition to its already-existing activities funding basic research, the "NSTF" would also be put in charge of a new technology-development mini-agency called the "Technology Directorate," which would function very much like a quasi-industrial policy agency. The Directorate would be given "DARPA-like authorities," with a highly flexible internal structure and the capacity to set its own targets and subsidize strategic technological fields. The Directorate's mandate would provide that it focus specifically on the industries that are critical for staving off the Chinese technological threat, including artificial intelligence, high performance computing, and several others.

Upon its initial release to the public, the bill's original co-sponsors focused on China as the primary motivation. Democratic Congressman Ro Khanna emphasized the bill's focus on cultivating "industries across our country that will be here to stay, or else risk losing our competitive edge to China."[viii] Republican Mike Gallagher issued a similar statement, promising that the bill would "ensure the CCP does not gain technological superiority in the future" by making "proactive investments in strategic technologies central to the competition." With the Democrats set to retake the White House, the EFA may have some chance at passing, particularly if the bill's appeal is as bipartisan as its co-sponsors claim—an effect of the nationalistic emphasis on competition with China, no doubt. The EFA would represent the most significant overhaul of the federal R&D system since at least the 1980s and potentially longer. The new NSTF would begin to look more like the agency envisioned by Harley Kilgore in the early 1940s: a centralized science and technology agency with broad powers to command both basic and applied research, all in the service of broader national technological goals.

The bill's weakness, however, is its overreliance on the very justification that might potentially lend it its bipartisan basis in the Congress. Simply put, competition with China may be a politically weak foundation upon which to build a new high-tech American industrial policy. The bill's cosponsors and its supporters in the press look to revive the great power technological rivalry that sent the federal R&D budget skyrocketing in the 1960s. They hope that China's steady progress into increasingly complex technological fields can revive the same national R&D mobilization of the post-Sputnik years. But whether this can drum up the same level of political support as the space race is highly uncertain. For one, the arena of technological competition today lacks the simple and appealing narrative of rockets, astronauts, and a contest to dominate the skies. Today, technological competition with China involves technologies that the broader public is barely even aware of, let alone understands: "quantum computing," "6G," "machine learning." There will be no new Kennedy basing nearly an entire presidential campaign on "the artificial intelligence gap." For this reason alone, even if the EFA does pass, it is likely to be little noticed by the broader public, and its reforms will therefore rest on shaky political ground.

There is also the downside that the shift toward a more planned innovation policy in order to combat China's technological prowess will have the secondary effect of playing into rising great power tensions. Once again, this risks linking the nation's R&D capacities with warmaking, a link that during and immediately after the Vietnam War prompted widespread dissent among the nation's scientific and technological communities, and ultimately led to broad-based defunding and scaling back of federal R&D. The dangers of the "New Cold War" may prompt a similar response in the near future from the would-be participants of the innovation system. This is particularly the case with technologies that bear a plausible connection with state power and surveillance, as nearly all of the technologies identified in the EFA do. If the federal R&D is seen as bound up with state motives that are fundamentally hostile, this bodes poorly for the industrial policy advocates who see China as the key to an American innovation renaissance.

The Frontier's End

A related though less prominent set of proposals, some of which also look to China as a complementary justification, see expansion and reform of the federal R&D system as a means of combating slow economic growth and the ongoing glut in productivity and innovation rates. "Secular stagnation," a term coined by economist Lawrence Summers, describes the new normal of slow growth and productivity that has plagued the American economy for the first two decades of the century, accentuated by the Great Recession. After the postwar "golden age" of nearly 4% GDP growth on average, as described in Chapter 3, economic growth slowed measurably in the mid 1970s and averaged below 3% for the next twenty-five years. The new millennium has brought a further deceleration, with growth rates below 2%, even when the deep recession year of 2009 is removed from consideration.[ix] Most projections now suggest that this trend may continue, with GDP growth by the end of the 2020s averaging around 1.5%.

This macro-trend has of course had monumental consequences for economic policy and politics. While the postwar boom years of high-speed development delivered rising wages to a growing middle class, the years since the onset of what Robert Brenner describes as the "Great Downturn" have been defined by a more zero-sum distributive politics, in which the already-well off claim a larger share of an ever-shrinking annual surplus.[x] Analysts have put forward a number of explanations for this macro-trend. Brenner, for example, attributes the steady decline in economic growth to global manufacturing overcapacity driven by the late maturation of Germany and Japan and the late industrialization of the East Asian "tigers," most of which relied upon aggressive industrial policy measures. Robert Gordon has put forward an alternative explanation rooted in technology, positing that the postwar boom years resulted from a historically unprecedented—and never to be repeated—wave of consumer-driven technological change. Gordon will be discussed further below.

Others still have pointed to the decline in R&D as a share of national GDP as a major cause of the slowdown, and have advocated for a sizable increase in public R&D as a compensatory mechanism. These analysts bear a close resemblance to Reich and the other liberal advocates of industrial policy of the late 1970s looking for solutions to that decade's economic woes. The clearest articulation of this view comes from Simon Johnson and Jonathan Gruber in their recent book *Jump-Starting America: How Breakthrough Science Can Revive Economic Growth and the American Dream.* Johnson and Gruber offer a broad overview of the history of federal R&D since WWII, and point specifically to the mid-1960s high point as a desirable model for total R&D outlays. They suggest that the federal government's commitment to R&D support was a critical factor in generating the high-growth years of the postwar era, and that a return to that level of support could potentially bring about a revival of those decades' economic miracle:

> The economic slowdown of the past few decades is not inevitable. Our economy can become dazzling again—both in terms of inventions and, more importantly, in terms of the prospects for most Americans...What we need is a sustained public- and private-sector push that scales up the innovation system, focusing on the creation of ideas that can be converted into technology...This will require the type of commitment to the federal funding of science that helped support our post-World War II boom.[xi]

Johnson and Gruber prescribe a substantial expansion of federal R&D and a "portfolio of high-risk and capital-intensive research and development that can lead to broad-based economic growth."[xii] They also propose a series of new programs that would aim to spread the employment and economic development benefits of R&D to lagging regions. To that end, they point specifically to Kilgore's idea for a geographically-equitable innovation policy—the first high-profile revival of the Kilgore vision in decades.[xiii] As noted in the introduction, Johnson and Gruber propose a new centralized "Innovation Commission" that would make recommendations for how to spread new “innovation hubs” across the country in a way that maximizes local economic development benefits.[xiv] Their proposal thus promises two separate economic benefits, both the standard deliverables of industrial policy: an economy-wide growth catalyst, which can supposedly help revive the postwar miracle, and place-specific development programs geared toward economically lagging areas.

The problem with Johnson and Gruber’s framing of the federal R&D system as the key to reviving growth in the American economy is that this simply may not work. If Robert Gordon and other growth-skeptical economists are correct, essentially no amount of sweeping technological advance could actually reproduce the postwar growth experience. The technological paradigm shift that delivered the postwar boom was the result of a historically unique combination of technologies that transformed everyday life—the personal automobile, the air conditioner, the dishwasher, and so on—all delivered in the temporary context of a global economy remarkably favorable to American firms. Even assuming that tomorrow’s most radical technologies are actually developed and brought to market—self-driving cars, smarter and faster computers, home-use 3D printers—they would still be unlikely to match the scale of the transformation wrought by mid-century high-consumption technologies.[xv] The transition to a fully industrialized, mass consumption society produced an economic miracle; the current transition, already fully underway, to a more automated, service-based economy may come up short.

This is basically a reworking of the New Deal-era argument encountered in Chapter 1 that the US had reached a phase of “economic maturity,” requiring a new policy framework prioritizing employment and stability rather than growth. That argument in the 1930s, of course, proved to be laughably premature. But it has now been nearly fifty years of basically uninterrupted underperformance compared to the postwar boom years, with strong indications that the future economy may churn along at an even slower pace. Though a recommitment to federal R&D may improve the economy along certain measures, it is unlikely to bring about the broad-based economic renaissance that Johnson and Gruber describe. As with the China-oriented framing, the danger with the growth-oriented defense of innovation policy is that its failure to deliver will produce a negative political fallout. Even if a more robust federal R&D system somehow could spark a return to high growth rates, this would be years in the making, and the political support for an ambitious national innovation program might wane in the meantime. Apart from near-term employment opportunities, which Johnson and Gruber do emphasize, there is little active political constituency for the long-term benefits of R&D programs. Roosevelt's note to Tugwell in 1932 that long-term planning "would have to grow rather than be campaigned for" was in some sense a recognition of this unfortunate reality.[xvi]

The Green Dream

A third justification for an innovation policy revival that has recently gained momentum is the use of public R&D to develop technologies that would help combat climate change. The federal government has long been a leading promoter of early-stage green technologies through the Department of Energy's many technology programs, ARPA-E, NSF, and others, but these have made up only a small share of the total federal R&D portfolio. Recent political advocacy has sought to change this: calls for a "Green New Deal" from progressive Democrats and activist groups imagine a large-scale green industrial mobilization led by the federal government, with technology and R&D a key pillar of this approach. New "public investments in the research and development of new clean and renewable energy technologies" was listed as a leading priority in Alexandria Ocasio-Cortez's Green New Deal resolution issued in Congress in early 2019, and groups such as the Sunrise Movement have looked for inspiration to the federal government's industrial mobilization experiments of the past.[xvii]

Though most of the technologies necessary to transition the economy toward a sustainable baseline already exist and are rapidly decreasing in price (solar power being the chief example), there is still a great need for R&D in the crucial area of decarbonization. Beyond some of the lower-tech decarbonization solutions found in agricultural techniques and reforestation, a high-tech complement of carbon capture and sequestration (CCS) could play a key role in managing the climate crisis. By mid-century, CCS technologies that use direct air capture—pulling carbon directly out of the atmosphere—could be developed and deployed on a mass scale. This would be a form of technological infrastructure akin to the satellite system—one so large in scale and without any immediate profit motive that only the state could develop it. A great deal of research remains to be done in other sub-areas of green technology as well, including battery storage, electric vehicles, and infrastructure and building materials.

The Green New Deal is a sprawling concept—for which it has drawn some criticism—and includes many types of federal interventions beyond investments in new technologies. But in the wake of its popularization by Ocasio-Cortez and others, left-leaning think-tanks and politicians have begun to turn to the climate issue as a new foundation for a more progressive federal innovation policy, and some of their ideas have made their way into more establishment circles. Like the China-weary R&D proponents and growth enthusiasts discussed above, advocates for a new green innovation policy have also invoked the federal innovation system's glory days as a model for the future. In her 2020 presidential primary campaign, Elizabeth Warren proposed a "Green Apollo Program" that took the R&D surge under Kennedy as a symbolic model.[xviii] Her campaign's press release called for "rapid innovation on par with the space race" through a $400 billion increase in R&D funding for green technologies along with a number of new area-specific agencies. The Biden campaign adopted most of Warren's green manufacturing and innovation policy, and the administration has made statements that it will prioritize green R&D, particularly in the area of decarbonization.

Aside from its obvious benefits in the effort to reduce emissions and decarbonize the atmosphere, a climate-oriented innovation policy would also likely rest on more solid political grounds. If issue polls are to be believed, the vast majority of the American public now understands climate change to be a serious threat, and the basic framework of the Green New Deal is popular.[xix] A federal government-led green industrial mobilization with R&D as one major component could create a powerful political constituency and ensure its own continuation. Unlike a China-focused innovation policy, green R&D does not rely on a new Cold War rationale or on technologies that might trigger a political backlash. And unlike a growth-oriented approach, it does not make overly ambitious near-term promises. Innovation is not a silver bullet for the climate crisis, but rather one key component of a more broad-based strategy. In some sense, the time horizon of the benefits of R&D are well-matched to the climate problem: the former may deliver just at the time when the latter is reaching a new stage of urgency.

Industrial Capital and the Future of R&D

The direction of R&D politics will depend on political shifts in the years to come. For now, the drumbeat for a new innovation policy is led primarily by China-anxious policymakers. Technological nationalism, it seems, is still the first instinct of industrial policy advocates in Washington and elsewhere. But the three orientations discussed above are also not necessarily mutually exclusive: one can imagine some form of hybrid that aims to combat Chinese competition, secular stagnation, and climate change simultaneously. The crisis brought on by the

COVID-19 and its resulting economic difficulties may also influence near-term calls for a new approach to R&D policy. The federal government's role in co-funding the Moderna vaccine, as well as its leading role in developing RNA vaccine technology through earlier NIH-led investments, may draw more attention to the potential of the federal innovation system.[xx] If the incoming Biden Administration's efforts to roll out the vaccine on a mass scale are successful, it could improve popular notions of the government's planning capacity. But as I have argued, the kind of large-scale expansion and institutional reform envisioned by the new innovation advocates will require a political grounding. If the federal R&D system is to play a more significant—and more recognized—role in the American political economy, the question of what the innovation system is *for* will need to be answered. As I have suggested, a climate-oriented innovation policy would provide the clearest answer, in addition to contributing directly to relieving the century's most pressing societal problem.

But the future of the R&D system will not be determined by "good policy" alone. The business community will continue to play a pivotal role in shaping federal innovation policy, as it has for the previous seven decades. Whether the US adopts a China-oriented or climate-based innovation policy, for example, could hinge on which segments of the business community can best make use of their political capital. In the new decentralized landscape of business lobbying, as discussed in Chapter 4, NAM no longer wields the outsized influence it once had over federal policy. Lobbying is done by a fractured mix of organizations and firms acting individually, and research-intensive universities have emerged as powerful forces in Washington. This fragmentation could cut in different ways for innovation policy. Without a single dominant R&D-oriented industrial organization, policymakers may be freer to explore major reforms of the R&D

system than they had been in the past. Alternatively, the cacophony of voices could prevent a clear direction for policy from emerging.

Whatever direction is ultimately chosen, the two key institutional choices examined in this study will continue to occupy a central place in the making of innovation policy. As discussed above, the discourse has shifted noticeably in favor of a more planned innovation policy. Policy circles spanning the political spectrum have rediscovered federal R&D as an economic policy lever, and politicians from Marco Rubio to Elizabeth Warren believe innovation policy can be better harnessed in a more rationalized and coordinated form. Even Kilgore himself has made a return, as in the case of Johnson and Gruber's book. At the time of this writing, the Biden Administration has already indicated that it will take the need for research coordination seriously. Biden has tapped MIT's Eric Lander as Director of the Office and Science and Technology Policy, which will now likely be elevated to a Cabinet-level post. One executive from the American Association for the Advancement of Science commented that the move signified an interest in "coordination that you can only get with a Cabinet-level position."[xxi] But the question of intellectual property resulting from federal R&D programs, which, as this study has argued, has always been the more contentious of the two, has also reappeared. With increased attention on the federal R&D system as a "hidden" developmental state has come a rising sentiment that the American public does not see a fair "return on its investment" in R&D—a notion popularized by Mariana Mazzucato, among others. The patent "giveaway," as Russell Long put it over fifty years ago, is one glaring example of this problem.

Meanwhile, the return of neo-Brandeisian progressivism in recent years may soon revive the New Deal-era framing of intellectual property as fundamentally a tool of monopolistic domination.[xxii] Thus far, the new antimonopoly movement has set its sights on the tech giants as its primary target.[xxiii] Progressive legal scholars and policy makers have drawn attention to the potential abuses led by Amazon, Facebook, and others as these firms have consolidated control over the digital economy.[xxiv] These critics see in the rise of tech industry behemoths the potential for similar kinds of anti-competitive behavior that motivated the neo-Brandeisians a century ago. Similar to the "patent power" that emerged in the Gilded Age, the control over intellectual property is one of the key mechanisms through which the new "tech barons" exert their influence. The patent system as a whole has not yet emerged as a focal point for the neo-neo-Brandeisians. There are indications, however, of an increased recognition that patents are being abused and may actually stifle innovation, perversely triggering a slowdown in innovation that they were designed to prevent.[xxv] For example, the rise of "patent trolls"—applicants that only wish to secure intellectual property for future litigation—is now a well-documented phenomenon. Critics of the "traditional" model of intellectual property have pointed out that in many technological fields, innovation can flourish even in the absence of IP rights through other forms of shared infrastructure and decentralized innovation sharing.[xxvi] If the new antimonopoly movement picks up on these long-brewing criticisms and begins to target the patent system, there may be a revival of the ambitious rethink of intellectual property during the 1930s and 40s. Just as in this previous era, government patent policy may be among the first priorities of a new anti-monopoly policy toolkit.

These sentiments have already translated into some high-profile policy proposals. Most significantly, the incoming Biden administration has announced plans for a new policy of "recoupment," in which private industry partners must repay the government the full value of any intellectual property resulting from government-backed R&D projects before they can take full ownership of it. If such a policy were adopted, and if even more dramatic reforms to government patent policy are down the road, this might trigger a new wave of controversy and resistance on the part of the business community that works with the government on research. As this study has demonstrated, ownership of government-funded IP has always been the critical issue for the private sector partners in the federal R&D system. If the basic arrangement that has been in place since the 1940s were put under threat, these partners would lose one of their fundamental incentives for participating in this system in the first place.

A deep contradiction thus lies at the heart of federal innovation policy and its potential for future reform. If the federal R&D system becomes more prominent as a mechanism for national economic policy making and transformation—as it did in the 1960s, for example—this will draw more attention to the practice of "contractor take all," which has always been intuitively troublesome, either as a pro-monopoly subsidy or a simple corporate windfall. A more robust and planned innovation policy may therefore be impossible without government patent policy reform, or least a renewed controversy over that reform. If these latter efforts go too far, they may alienate the very firms upon which the central mechanism of public-private action in the R&D system has long relied. Reform of the federal R&D system may hinge on the resolution of this contradiction: the system cannot remain "hidden," nor can it completely do away with the leading incentive for private sector participation. The alternative is a system in which the state itself performs more of the actual research—through, for example, expanded government labs and development centers. But if a revitalized federal innovation policy is to still rely on the private sector for much of publicly funded R&D, some new institutional compromise will need to be invented.

[i] As discussed in: Block, Fred L., and Matthew R. Keller. *State of Innovation: the U.S. Government's Role in Technology Development*. Routledge, 2011.
[ii] Brady, Jeff. "After Solyndra Loss, U.S. Energy Loan Program Turning A Profit." *NPR*, NPR, 13 Nov. 2014, www.npr.org/2014/11/13/363572151/after-solyndra-loss-u-s-energy-loan-program-turning-a-profit.
[iii] If true, this would be nothing new in development catch-up strategies, as argued by Ha-Joon Chang in: Chang, H.-J. *Kicking Away the Ladder: Development Strategy in Historical Perspective*. Anthem Press, 2003.
[iv] "The Department of Justice's National Security Division Chief Addresses China's Campaign to Steal U.S. Intellectual Property." The National Law Review, www.natlawreview.com/article/department-justice-s-national-security-division-chief-addresses-china-s-campaign-to.
[v] "The Arrest of a Harvard Professor: News: The Harvard Crimson." *News | The Harvard Crimson*, www.thecrimson.com/article/2020/5/27/commencement-2020-lieber/.
[vi] Rubio, Marco, US Senate Small Business Committee, "Made in China 25 and the Future of American Industry." https://www.rubio.senate.gov/public/_cache/files/d1c6db46-1a68-481a-b96e-356c8100f1b7/3EDECA923DB439A8E884C6229A4C6003.02.12.19-final-sbc-project-mic2025-report.pdf
[vii] *Id.* at 67.
[viii] Release: Khanna, Schumer, Young, Gallagher Unveil Endless Frontier Act To Bolster U.S. Leadership In Science And Tech Innovation And Dramatically Increase Investment In Emerging Tech As China Seeks To Leverage The Coronavirus Pandemic For Their Gain *Congressman Ro Khanna*, 27 May 2020, khanna.house.gov/media/press-releases/release-khanna-schumer-young-gallagher-unveil-endless-frontier-act-bolster-us.
[ix] "U.S. Economy at a Glance." *U.S. Economy at a Glance | U.S. Bureau of Economic Analysis (BEA)*, www.bea.gov/news/glance.
[x] Brenner, Robert. *Economics of Global Turbulence*. Verso Books, 2005.
[xi] Gruber, Jonathan, and Simon Johnson. *Jump-Starting America: How Breakthrough Science Can Revive Economic Growth and the American Dream*. PublicAffairs, 2019, at 11.
[xii] *Id.* at 176.
[xiii] *Id.* at 180.
[xiv] *Id.* at 184.
[xv] Gordon, Robert J. *The Rise and Fall of American Growth: the U.S. Standard of Living since the Civil War*. Princeton University Press, 2017.
[xvi] Schlesinger, Arthur M. *The Crisis of the Old Order 1919-1933*. Houghton Mifflin Co., 1957, at 421.
[xvii] Ocasio-Cortez, Alexandria. "Text - H.Res.109 - 116th Congress (2019-2020): Recognizing the Duty of the Federal Government to Create a Green New Deal." *Congress.gov*, 12 Feb. 2019, www.congress.gov/bill/116th-congress/house-resolution/109/text.
[xviii] Warren, Team. "My Green Manufacturing Plan for America." *Medium*, Medium, 7 June 2019, medium.com/@teamwarren/my-green-manufacturing-plan-for-america-fc0ad53ab614.
[xix] Teirstein, Zoya. "Poll: The Green New Deal Is as Popular as Legalizing Weed." *Grist*, 22 July 2019, grist.org/article/poll-the-green-new-deal-is-as-popular-as-legalizing-weed/.
[xx] Allen, Arthur. "For Billion-Dollar COVID Vaccines, Basic Government-Funded Science Laid the Groundwork." *Scientific American*, Scientific American, 18 Nov. 2020,

www.scientificamerican.com/article/for-billion-dollar-covid-vaccines-basic-government-funded-science-laid-the-groundwork/.

[xxi] Kaplan, Sarah. “Biden Will Elevate White House Science Office to Cabinet-Level.” *The Washington Post*, WP Company, 15 Jan. 2021, www.washingtonpost.com/science/2021/01/15/biden-lander-ostp/.

[xxii] E.g., Wu, Tim. *The Curse of Bigness: How Corporate Giants Came to Rule the World*. Atlantic Books, 2020. *See also* Khan, Lina. “The New Brandeis Movement: America’s Antimonopoly Debate.” *Journal of European Competition Law & Practice*, vol. 9, no. 3, 2018, pp. 131–132., doi:10.1093/jeclap/lpy020.

[xxiii] E.g., Hazlett, Thomas W. “U.S. Antitrust Policy in the Age of Amazon, Google, Microsoft, Apple, Netflix and Facebook.” *SSRN Electronic Journal*, 2020, doi:10.2139/ssrn.3594934.

[xxiv] Khan, Lina. “Amazon’s Antitrust Paradox,” 126 *Yale Law Journal* 710, 2017. See also Khan, “Sources of Tech Platform Power,” 2 *Georgetown Law & Technology Review* 325 (2018).

[xxv] Baker, Dean. *Rigged: How Globalization and the Rules of the Modern Economy Were Structured to Make the Rich Richer*. Center for Economic and Policy Research, 2016. 77-130.

[xxvi] E.g., Kapczynski, Amy. “Order without Intellectual Property Law: Open Science in Influenza.” 2018, doi:10.31228/osf.io/6ep4x. Ouellette, Lisa Larrimore, Nanotechnology and Innovation Policy, 29 Harvard Journal of Law and Technology. 33–75 (2015). Grewal, David Singh, Before Peer Production: Infrastructure Gaps and the Architecture of Openness in Synthetic Biology. 20 Stanford L. & Tech. Rev. 143 (2017).