



# The Public Role in Economic Transformation: Lessons from World War II

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## INTRODUCTION

In a serious crisis, government must take on a larger role in the economy. Few dispute this, even among those with a strong aversion to an active public sector in normal times. As many people have noted in recent weeks, there are no libertarians in a pandemic.

This is a lesson we are all learning today. In response to the coronavirus, the unthinkable is quickly becoming thinkable. As of March 24, Congress is considering a \$2 trillion stimulus; a \$1,200 grant to all Americans; bailouts of firms facing bankruptcy; suspension of rent, student-loan, and mortgage payments; and drastic restrictions on travel and commerce. In Europe, where until recently the consensus was in favor of privatizing publicly owned firms, the governments of Spain and Italy have moved to nationalize private hospitals. In France, President Emmanuel Macron has announced the suspension of rent, taxes, and utility bills. In the US, similar steps are being taken by state and local governments, with an increasing range of choices about payments and economic activity normally left to the private sector now being taken over by the public. Even President Donald Trump, who initially downplayed the crisis, now refers to himself as a “wartime president.”

The coronavirus pandemic is— let us hope—a temporary emergency. The lessons we learn from it will need to be internalized more fully, and more persistently, as we wake up to a more lasting emergency: the climate crisis, which will be with us for generations.

The responses to the coronavirus are of necessity largely improvisations, taken in response to the immediate needs of the crisis. But as we contemplate a vastly expanded role of government, and as we ask what lessons the coronavirus crisis has for the rolling crises of climate change, it’s worth looking for lessons from previous episodes when the government was forced to rapidly expand its role in response to a national emergency. In American history, the outstanding case is the mobilization for World War II, which holds valuable lessons for today’s policymakers.

In this paper, we focus on the government’s role in rapidly building up war industries. This experience will be relevant if the US needs to drastically scale up the health care system or make other large-scale economic adjustments in response to the coronavirus. It will be even more relevant for the transformation of all kinds of economic activity required for deep decarbonization.

We draw three broad lessons from the experience of building up war industries in the early 1940s. First, the more rapidly the economy must be reorganized, the greater the direct role for government must be. When a transition between industries or technologies can happen slowly, over many years, government intervention can operate mainly through the price mechanism, encouraging some activities with subsidies and discouraging others with taxes or fees. But when a transition must happen rapidly, these tools are insufficient, and the government must act more directly, channeling credit directly or even carrying out the needed spending itself. If large parts of US industry functioned as, in effect, a planned economy during World War II, this was not because that’s what policymakers wanted, but because there was no other way to reorient it toward military production fast enough.

The second lesson is that the public sector is especially critical for long-term investment. During the war, most military production continued to be carried out by private businesses on contract with the government. Only in a small number of cases were production facilities directly managed and staffed with public employees. But the great bulk of investment was carried out by the federal government. In response to the coronavirus crisis, and to the rolling crises of climate change—some to come, some already here—we can expect a similar division of labor between public and private. There is no reason to expect the government to take over the routine distribution of most goods and services. But where major expansions of capacity are required, the government likely must take a much more direct role. It is exceedingly unlikely, for instance, that any conceivable price signal would lead profit-seeking businesses to build out new hospital beds on the scale that a public health crisis like the coronavirus may require.

The third lesson is linked to the second: A key strength of the government is its capacity to bear risk. A major reason that the private sector was unwilling to expand capacity for military production during World War II—and may be equally reluctant to expand capacity in the sectors we need to grow today—was the great uncertainty about future conditions. Even where there is a clear-cut technical problem to be solved in meeting an urgent social need—developing a vaccine for a new virus or, for instance, developing the energy-storage capacity required for a complete transition to renewable energy—the commercial questions may be much murkier. For the government, the question around developing a vaccine is whether it will work, and whether it has any serious side effects; the private sector must also be concerned with the price at which it will be sold, the degree of competition it will face, the regulations that will have to be complied with, and so on, as well as broader questions of demand and financial conditions. In conditions of economic uncertainty, private businesses may be unwilling to invest, even if the social costs and benefits are reasonably clear. For this reason, the role of the government as risk-bearer becomes more important as uncertainties are greater. This means, in particular, that the public role must be greater when technological and social change is faster. It also means that government must be willing to risk supporting projects that fail. If public investment is limited to loans on “sound, commercial principles,” as the federal government initially attempted during the rearmament period of 1940–1941, that will squander one of the public sector’s greatest strengths.

The remainder of this paper is organized in four sections. In the first, we briefly summarize some of the major policies used during World War II to boost military production; in this section, we show how the Roosevelt administration found itself gradually forced to take on a more direct role in organizing military production. In the second section, we discuss the general lessons the wartime experience teaches us about the need for a more direct role for the government in rapid economic transformations. In the third section, we discuss the government’s role in investment specifically. And in the fourth section, we talk about the importance of the government as ultimate risk-bearer.

## **PUBLIC SECTOR PROGRAMS TO BOOST CAPACITY IN WAR INDUSTRIES**

During the war years, the federal government played a central role in directing production. In particular, it either financed or carried out the great majority of investment. But, importantly, this was not the intention when the administration began planning for the war. On the contrary, the expectation was that military orders could be met by private businesses under their own direction, with raw materials sourced through markets and investment carried out by private business using private financing. The government was forced into a more direct role only by the inability of the private sector to meet the urgent need to boost output in war industries—a failure that has parallels in the present.

At the start of the armament period, it was widely assumed that the profitability of procurement would be sufficient inducement for businesses to increase capacity as needed. Reconstruction Finance Corporation (RFC) head Jesse Jones—perhaps the central figure in economic planning on the eve of the war—expressed the conventional view in 1940 when he predicted that the federal government had no intention to construct or own industrial facilities: “Private sources will be expected to handle the greater part of capital demand from the war program that falls into the category of permanent expansion of plant” (White 1949).

Private businesses and financiers similarly expected to be responsible for any expansion of capacity required by the war effort. In 1940, for example, National City Bank confidently predicted that “expansion [would] go forward and be financed under private auspices” (White 1949). Even once it was clear that the government would have to play a larger and more direct role, many business leaders strenuously resisted an increase in public financing or investment. The head of the Investment Bankers Association publicly worried how “those of a socialist bent” would use “these new government-financed plants when the emergency ends,” while his counterpart at the American Bankers Association argued that the “future independence of business may depend on the extent to which the bankers finance defense orders.” Other business leaders went further, suggesting that it might be better to lose the war than to win with a greatly expanded public sector. J. Howard Pew of Sun Oil, for example, argued that if war production “supinely relies on government control and operation, then Hitlerism wins even though Hitler himself be defeated,” while General Motors chairman Alfred Sloan—referring to the danger of government enterprises continuing to operate after war—wondered if “it is not as essential to win the peace in an economic sense as it is to win the war in a military sense” (Wilson 2016).

It’s worth noting that the intense opposition from business leaders to an expanded public role somewhat contradicts the idea that the massive expansion of public spending was possible only because of a universally shared desire to win the war. While patriotism and public spiritedness undoubtedly contributed to the success of the war mobilization—just as there has been a collective willingness to make great sacrifices to limit the spread of the coronavirus—the idea that political and ideological conflicts disappeared during the war is ahistorical.

This resistance to a direct federal role was not overcome thanks to an ideological commitment to a larger public sector. Rather, the turn to direct public investment happened by necessity, despite the intentions of most policymakers at the start of the war. It proved to be impossible to scale up production on the scale and with the speed called for in any other way. Private businesses and private banks were unwilling or unable to bear the risks associated with a vast increase in production capacity, given the uncertainty about the length of the war and what conditions would be like afterward. This uncertainty was greatest in new sectors, like aircraft, where the federal role was correspondingly greater. And where rapid expansion had to be carried out in unison across a number of complementary sectors, only the federal government was able to provide the required coordination. Thus, the federal government was forced to take a leading role in wartime investment despite the considerable resistance this faced.

Below, we briefly describe some of the most important programs that supported investment in war industries.

Despite the variety of approaches, there is a clear pattern to the degree of public investment in various industries. In established sectors like steel, where the war did not see any major technological changes, the large majority of investment was carried out by incumbent private firms (though the federal government still played an important role in financing it). In industries where wartime production was orders of magnitude greater than prewar and involved major technological advances, such as aircraft, the federal role was much greater, with the government typically owning the plants and not just financing them. And in industries that did not exist prior to the war, such as uranium enrichment and synthetic rubber, the federal government carried out essentially all investment.

This pattern clearly demonstrates that the role of the federal government in investment was not simply about providing money; it was about bearing risk and about substituting judgment for market signals. The more production departed from prewar patterns, the less established markets were to guide allocation and production decisions, and the more uncertainty there was about the future prospects of an industry, the more necessary a direct federal role was in that industry. It is likely that a similar pattern will be found in future efforts to reorient production in response to urgent social needs.

## **Tax Credits**

The most straightforward way to encourage investment is to subsidize it, perhaps through tax credits. This approach was tried during the mobilization, but with limited success. Early in the defense preparation period (before Pearl Harbor), the main tool used to encourage the expansion of productive capacity was accelerated depreciation, which reduced a firm's tax liability. Plant and equipment investment deemed essential to defense needs was allowed, for tax purposes, to be depreciated at 20 percent per year as opposed to the normal 5 percent and 10 percent depreciation allowance for structures and equipment respectively (White 1980, 8–9).

The \$6.5 billion (\$92.4 billion in 2020 dollars) in facilities covered by this program accounted for approximately 20 percent of private fixed investment during the war. But its actual impact on war production was much less than this figure would suggest, because the projects tended to be the safest types of investment, with a clear postwar use. It is probable that these tax credits at best encouraged the kind of investment that was likely to take place anyway.

### **Future Reimbursement: The Emergency Plant Facilities Program**

The next step from tax credits is to leave investment decisions in the hands of private business and finance, but to reimburse the company carrying out the investment after the fact. This approach was embodied in the Emergency Plant Facilities Program (EPF), an early experiment in government financing of plant expansion in which the military guaranteed to eventually reimburse contractors for the full costs of new plants.

The EPF was pushed by conservative members of the National Defense Research Committee, an early war planning agency; they accepted the need for public financing but wanted it to depart as little as possible from existing models of military contracts (White 1980). Under the EPF, contractors would need to privately finance their investments, using their own funds or bank loans. Once the plants were built, however, the government would then repay the contractor for the capital costs over 60 monthly payments. Payments were assignable to a third party to allow them to be used as collateral, in the hopes of encouraging private lending. At the end of the 60 payments, the government would take possession of the plant. The operator would then have the option to buy the plant at cost minus depreciation (White 1949).

Because the EPF approach required contractors to make the initial outlay for construction, and because it relied on the participation of private lenders, it left too much risk with the private sector to motivate significant investment. Because the 60 payments would not commence until after completion of the plant, and the loans needed upfront to finance plants were often very large, banks still saw the loans as carrying significant risk, especially given the scale of lending required. On the other hand, the EPF still committed the public sector to eventually bearing the full costs of construction, so the private financing served no real purpose: If the program worked as designed, the federal government would end up paying the full cost of plants. This was not desirable for the armed forces, whose budgets, large as they were, were stretched by procurement and the massive investment needed to fuel the war.

This combination of forcing private contractors to bear large initial risks but committing the military to large payouts to them in the future was the exact opposite of what was called for. As discussed below, a critical role of the federal government in fostering investment—during World War II, during the coronavirus pandemic, and in decarbonization—is to bear risk, to reduce the uncertainty that limits private investment. The EPF offered such large potential payouts for private businesses that they were seen as a problem even for the financially unconstrained wartime state. At the same time, it required the private contractors and their bankers to take all the risk of the plant failing to perform as expected or the war ending early, squandering the government's greater capacity to bear risk. This

was the worst of both worlds. It left private actors to find private financing without significantly reducing uncertainty—which was the problem that needed to be solved in the first place—while still committing the armed forces to bear the full cost of the plants.

Of all the investment programs discussed here, the EPF was the smallest. It was nonetheless important as an early experiment in direct government financing of private investment, and helped pave the way for the more successful schemes adopted afterward. Once the Defense Plant Corporation was established, the EPF quickly faded into oblivion.

### **Direct Public Investment: The Defense Plant Corporation**

One way for the government to encourage investment is simply to carry out the investment itself. Even when the public sector orders, pays for, and owns plant and equipment, it can still be operated by private companies if there are reasons to prefer that. This was the dominant model of investment during the war, carried out mainly through the Defense Plant Corporation (DPC).

The DPC emerged out of the RFC, which was the major vehicle to support private investment within the New Deal. In 1940, while the country was still at peace, but as military production began to ramp up, the RFC was granted the power to make loans for defense purposes. The RFC was largely ineffective in this role, however, because of its commitment to making loans on sound commercial principles. Under 1934 legislation that was still in force in 1940, the RFC could lend only in cases where credit was not available from private sources; at the same time, it could only make loans “of such sound value, or so secured, as reasonably to assure retirement or repayment” (White 1949). These provisions made sense in 1934, when the private banking system was largely shut down and even the safest projects might not be able to find financing. But by 1940, they essentially canceled each other out, severely limiting RFC lending.

To overcome this, in August 1940, the RFC created the DPC as a corporate subsidiary, which went on to finance and own roughly one-third of the plant and equipment built during the war. Unlike the EPF, the DPC did not simply commit the government to reimburse contractors for the costs of plant expansion; the DPC itself directly built and owned the plants that it paid for. Most in the administration had initially hoped that a smaller public role would be sufficient, but given the extreme reluctance of private businesses to bear the risks associated with expanding productive capacity for the war effort, it turned out that only the DPC approach was sufficient. This was especially true in newer industries such as aircraft, where the DPC was responsible for the great bulk of wartime investment.

As Gerald White writes in his definitive history of the DPC, “[T]he sheer size of the expansion [of aircraft production] made virtually certain that much of the financing would have to come from the government sources” (1980, 18). While aircraft production was of particular concern, other strategic industries, such as synthetic rubber and metals-producing industries, also required large government financing of investment.

The problem the DPC solved is illustrated by the negotiation for a large and early wartime loan to Wright Aeronautical, a producer of airplane engines that was unable to expand capacity to produce the 12,000 engines required in their defense contract. The original RFC proposal was to lend to Wright Aeronautical for this plant construction and for the loan payment to be amortized on a per-engine basis—a similar arrangement to the Emergency Plant Facilities program discussed above. This arrangement met with significant resistance from both Wright and from elsewhere in the administration. On the one hand, the loan would leave Wright in great financial difficulties if the promised orders failed to arrive. On the other hand, if the deal proceeded as planned, then Wright would effectively pay back the loan with government funds, leaving the company with ownership of a plant it had not paid for. To protect what the RFC saw as “the government’s interest,” the DPC would be not merely a lender but the owner of the plant. Wright would then lease the plant from the DPC for a nominal one dollar per year. This model of government ownership and private operation turned out to be the right one for war finance; it made the government the risk-bearer and residual claimant on wartime investment, while giving private business a limited but secure flow of profits.

Through 1945, the DPC authorized \$9.7 billion (\$137.9 billion in 2020 dollars) and disbursed \$7.8 billion. The aircraft industry received the largest amount, just over \$3 billion. (For comparison, total private investment during the war was on the order of \$30 billion.) The synthetic rubber industry received just under \$0.8 billion. Metals-producing industries such as iron and steel, as well as magnesium and the aluminum industry (crucial to aircraft production) received \$2.2 billion (White 1980, 70 Table 6).

These debates over wartime financing arrangements may seem obscure, but they have direct relevance to debates over both public health and decarbonization today, because they clearly bring out the relative strengths of the private and public sectors. There are good reasons to encourage a private role in production, where private firms have the relevant expertise and organizational capacity and are already engaged in related activities. But there are two major caveats. First, government can support private investment most effectively by removing risk, not by offering large financial inducements. The reality of investment is that many of the activities we want to encourage are already profitable, but that exceptionally large profits are needed to offset uncertainty; thus, a program that focuses on incentives runs the risk of simultaneously generating too little investment and creating excessively large payouts for the firms that do participate. Second, the comparative advantage of the private sector is in production. Private participation on the financing side contributes little and offers many opportunities for rent-seeking.

### **Supporting Investment by Guaranteeing Demand: The Machine Tools Pool Program**

While conventional economic theory sees a tight link between investment and interest rates, Keynesian economists have long argued that investment responds most strongly to demand. Accordingly, wartime investment programs also included demand-side support in the form of guaranteed orders. This was important especially for smaller businesses, for whom uncertainty about



future sales is a major problem. More broadly, and contrary to ideological stereotypes, it is often small businesses that benefit most from public support for investment.

In this context, a particularly interesting wartime program is the machine tools pool program, which was intended to ensure the supply of crucial intermediate goods to war industries. Here, risk-bearing by the federal government took the form not of public investment but of guaranteeing a market.

Machine tools—such as industrial lathes; drills; and shaping, grinding, and pressing machines—are the foundation of industrial production. During World War II, the production of these tools represented a massive potential bottleneck in the production process. As with other industries touched by the production expansion in WWII, the machine tool industry was haunted by the memory of the sudden and deep losses sustained with the sudden cancelation of wartime contracts after World War I. Following that war, the military had abruptly canceled great numbers of contracts, leading to massive losses for firms that had scaled up production to meet military demand during the war. This was a major factor discouraging expansion in 1940.

These concerns were especially important in the machine tool sector, because unlike most war industries, it consisted of a large number of small, specialized firms, rather than a few large, integrated firms—as in basic metals, aircraft, autos, and most other sectors producing for the military. These firms had little financial capacity to handle losses if they produced more than they were able to sell quickly, and a limited ability to reorient production toward civilian demand if military orders dropped off unexpectedly.

To encourage investment in the machine tools industry, the federal government needed to assure producers that a robust and stable market for their product existed. This was especially important given that producers were aware of how many military orders had been canceled without warning at the end of World War I. The machine tool pool financed by the DPC provided a market and a predictable price for machine tool output.

Through the pool, the DPC provided a 30 percent advance on machine tool orders, refundable when the tool producer found a buyer. If the producer did not find a buyer for their output, the machine tool would be put into storage, and the DPC would be billed for the remaining 70 percent. Generally, private buyers were found, and of machine tool pool orders of just under \$2 billion, the DPC placed just \$23 million in storage, eventually selling \$21 million of that inventory. Thus, while the reduction in risk for individual small producers was critical, the cost to the government was minimal. Overall losses on the machine tool pool were well under 1 percent (Stoughton 1949, 69; White 1980, 87).

There were a number of benefits to the machine tool pool aside from simply guaranteeing a supply of a key capital input, which may be relevant for analogous producers of medical supplies, as well as for many sectors of the green economy. Most important was the speeding up of the production process. In peacetime, there was often a long lag between a rise in ultimate demand and an increase in

machine tools production. First, a potential buyer of machine tools had to secure an order for output themselves. Only after final goods producers had secured their own contracts did they then turn to ordering machine tools. The pool allowed machine tool producers to ramp up production before specific buyers were known. Stoughton (1949) reports that the tool pool helped shave off six months of the production of a four-engine bomber. By encouraging machine tool producers to operate at maximum capacity, the pool also brought to this dispersed sector some of the efficiencies inherent in mass production. The size and centralization of the pool forced the industry to adopt uniform standards, as contracts were for standardized machine tools.

The experience of the machine tool pool illustrates an important role for the public sector in coordinating between dispersed small producers. Contrary to an idealized textbook vision of the economy, the price mechanism would have done a poor job guiding machine tool production, as wartime planners understood. Removing the risks to machine tool producers from uncertain future order flow was essential to allow them to produce at a consistently high level, especially since, as small enterprises, they had limited financial capacity to ramp up production in anticipation of future demand.

### **Loan Guarantees: The V Loan Program**

The DPC and its subsidiaries were designed to substitute public finance for private finance. But the risk-bearing capacity of the federal government was also used to support private lending. The V loan program was created to insulate private lenders from credit risk. Under this program, the branch of the armed forces initiating a contract would guarantee bank loans to the firm they were contracting. If the contractor failed to repay the loan, the military would repay the bank for some large percentage of the default losses. By removing most risk from loans to war contractors, this was intended to encourage private financing for investment.

The V loan program had a relatively small effect on overall war financing, which remained overwhelmingly public. But it had a large effect on private financing: The share of bank loans going to war industries tripled after the program was introduced. As such, it offers a useful case study in how targeted loan grantees can help firms access private financing under an arrangement that is essentially costless to the federal government.

Emerging in 1942 as investment in war industries rapidly expanded, V loans were a way for the federal government to share financing of war production with private lenders (Fuller 1948). Through the V loan program, roughly \$10.3 billion (\$146.4 billion in 2020 dollars) was lent in 8,771 loans over the course of the war (Burr and Sette 1950, Table 1). This was a relatively small portion of overall war financing, with private bank lending accounting for only 7.3 percent of working capital in war industries at the end of 1945 (Fuller 1946, 126). But this should be compared to the 3.2 percent financed by banks at the end of 1941, before the institution of the V loan program. According to Gerald Conkling (1945), the introduction of the V loan program was largely responsible for the

increase in war lending from 6 percent of bank loans in 1941 to 15 percent by the end of 1942, and 18 percent in 1943.

At their peak in 1944, V Loans accounted for 66 percent of total war lending by private banks (Burr and Sette 1950, Table 3). The program also turned a small profit for the federal government. Losses on these loans were very small, about 0.06 percent of actual loans made. The contract agencies earned a small net profit—ignoring administrative costs—of \$23 million between 1942 and 1949<sup>1</sup> (Burr and Sette 1950, 58). Today, loan guarantees are getting renewed attention as tools to channel credit toward investment decarbonization (Pollin 2015, 97–98). This wartime precedent is worth studying.

### **Direct Public Investment: Synthetic Rubber**

In most industries, while the federal government either directly paid for and owned, or financed, most new plants, it left production itself to private businesses. The major exceptions were shipbuilding, where the military had always maintained substantial capacity, and industries that did not exist prior to the war. Besides those associated with the nuclear weapons program, the main industry in this latter group was synthetic rubber.

Synthetic rubber is a singular example in US history of an industry created out of whole cloth by the federal government. With the capture of almost all supplies of natural rubber by the Japanese, the development of synthetic rubber production was a critical priority. These facilities were built, financed, and owned by the Defense Plant Corporation, and continued to be publicly owned until the mid-1950s.

Some forms of synthetic rubber had been developed in the 1920s and 1930s and used in relatively small quantities by the Germans and the Soviets. However, in the 1930s, easy access to ample and cheap natural rubber suppressed any real interest in developing synthetic rubber outside of some specialty uses; this early synthetic rubber could not compete with natural rubber either in terms of quality or price (Morton 1981).

By the beginning of 1942, the Japanese had captured 97 percent of the US's rubber supply (Tuttle 1981). Rubber was a necessary input for a number of products, from shoes to medical supplies; but most importantly, mechanized warfare was impossible without rubber tires and other crucial rubber components such as O-rings and gaskets. Rubber was needed not only to supply the US and allied military needs but also the US civilian economy, which, by the early 1940s, was heavily dependent on the automobile (Herbert and Bisio 1985).

Rubber plantations in South America were fostered after the loss of Pacific rubber production, but this rubber was scarce and expensive.<sup>2</sup> To supply the bulk of this crucial commodity, the DPC laid out

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<sup>1</sup> Part of income for agencies from the V loan program came from shared “commitment fees” banks charged borrowers for keeping lines of credit open.

<sup>2</sup> Grandin (2010) gives a fascinating account of an ultimately unsuccessful effort to develop rubber production in Brazil.

\$700 million (\$10 billion in 2020 dollars) for the construction of 51 plants able to produce 845,000 tons of the most common type of synthetic rubber (Morton 1981). The result was an increase in the production of synthetic rubber by over 3,000 percent between 1941 and 1945<sup>3</sup> (Morton 1981, Table 2). In addition, the federal government spent some \$13.5 million on research and development support through 1949 (Solo 1954). This included foundational research carried out at universities, as well as more targeted research geared toward military and commercial applications.

After the war, the federal government maintained control of most synthetic rubber production, which was regarded as necessary for national security. Production then spiked again during the Korean War. Between the wars, a “cold rubber” process of making synthetic rubber finally achieved the original objective of the rubber program to create a synthetic rubber of a high enough quality to be commercially competitive with natural rubber. After this was achieved in the late 1940s, the federal government rolled up the R&D efforts, and after the Korean War, plants were sold off. This sale turned a small profit on the original costs of the plants. These profits were in addition to the substantial revenue earned from ownership of the DPC-owned facilities that were operated by private firms.

The synthetic rubber program suggests several general lessons. First, it is consistent with the broader pattern where, the greater the departure from existing forms of production, the greater the role of the federal government. It is not a coincidence that the only two major war industries that were entirely owned by the federal government during World War II, synthetic rubber and uranium enrichment, were the two that had not existed at all prior to it. Second, it shows that—contrary to widespread opinion both in the 1940s and today—the public sector is capable of developing and running an industry that can be competitive with private sector enterprises in the market. The fact that the government eventually sold the synthetic rubber plants at a profit demonstrates that the expenditure was not “wasteful” by business criteria, even aside from its value in winning the war.

### **General Lessons on Investment Finance**

This range of wartime experiments with public investment in industry has important lessons for dealing with public health emergencies, and even more for the larger challenge of decarbonization. First, it is a reminder of the principle that markets offer more reliable inducements for current production than for long-term investment. Second, it demonstrates that the great advantage the public sector brings is its capacity to bear risk. Third, the variety of forms that public investment took suggests that it is unlikely that the best institutional arrangements for fostering socially needed investment will be obvious at the outset. If the wartime experience is a guide, it may be necessary to experiment with a number of different arrangements for encouraging investment—ranging from simple incentives or subsidies, through the subsidization of private finance, through public finance, to direct public investment—before the right mix is achieved.

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<sup>3</sup> Between 1941 and 1955, synthetic rubber production increased by roughly 10,000 percent (Boyle 1961, 152).

Fourth, the wartime experience—in particular, the machine tool pool—suggests that a public role in coordinating and centralizing markets may be more important when there are many dispersed smaller producers. Contrary to conventional wisdom about the antagonism between government and small business, the role of the public sector may need to be larger when we have, or want, a market of many competitive small producers rather than one of a few dominant corporations. This will be especially relevant for agriculture, where programs to guarantee demand for the output of dispersed small producers are already the norm. Fifth, the wartime experience with new industries such as synthetic rubber suggests that the greater the departure from the existing organization of production, the greater the need for public sector involvement will be. In areas where all that is needed is a wider deployment of existing technologies, simple incentives and devices such as loan guarantees may be sufficient. In areas where fundamentally new technologies are required, or where production needs to be organized in fundamentally different ways, the public sector will need to play a more a direct role, financing or even carrying out the investment itself.

In short, when thinking about the role of the public sector in fostering investment in new industries or technologies, we should not think of it as merely providing resources. Additionally, and even more critically, its role is to *bear risk* and to *solve coordination problems*, both of which it can do in a way that private businesses cannot.

## **THE MORE—AND FASTER—THE ECONOMY NEEDS TO CHANGE, THE MORE PLANNING IT NEEDS**

*More than at any other period in US history, the wartime economy was a planned economy. The massive, rapid shift from civilian to military production required far more conscious direction than the normal process of economic growth. The national response to the coronavirus and the transition away from carbon will also require higher than normal degrees of economic planning by government.*

In the US, the economic problems of allocation and production have historically been predominantly—though never exclusively—the responsibility of private businesses. While government has always been expected to provide the institutional framework for markets—such as courts and contract enforcement—as well as a few public goods, most goods and services are expected to be allocated primarily through markets. Decisions about investment, meanwhile, are made by profit-seeking corporations and banks. While the exact boundaries between private and public have always been contested, the basic economic decisions made by dispersed private businesses have generally been accepted by policymakers and the majority of the public.

A decentralized system of production works acceptably well—if not necessarily equitably—when it is a question of making many small decisions, where the people who make the decisions are directly responsible for the costs and benefits of the decisions. These decisions can be made more or less in isolation, on the assumption that the overall contours of the economy will remain basically

unchanged. But the system quickly breaks down when it is a question of making rapid, large-scale changes in the economy as a whole. Such large-scale transformations need to be actively managed by the national government. This need for active managing of major economic transitions has been experienced by almost every country that has rapidly industrialized, including the US.<sup>4</sup> It is also one of the central lessons of World War II. There is little question that the same shortcomings of decentralized markets will become clear during a rapid transition away from carbon—and are becoming clear during the coronavirus pandemic.

From 8 to 10 percent of GDP during the 1930s, federal spending rose to an average of around 40 percent of GDP from 1942 to 1945. Government payrolls, both for soldiers and for the large expansion in federal government civilian employment, accounted for 7 to 8 percent of GDP during the war, while contract spending on goods and services accounted for 23 percent on average during the war. So economically, the bulk of the war effort consisted not of hiring and deploying soldiers, but of eliciting military production from private businesses.

There were three main, interlinked reasons why the wartime mobilization required a major expansion of public planning.

The first was the simple problem of coordination—the need for many sectors and activities to expand together. In normal times, market coordination relies on a tacit assumption that current conditions will continue into the future. But when a major change in activity is involved, this doesn't work. Major expansions in capacity may need to come before there is a clear market, and multiple industries that depend on each other may all need to expand together. The second reason is the problem of finance and risk. Major expansions of capacity are likely to be well beyond the financial capacity of existing firms, especially when they involve developing new sectors where there are no existing large corporations. And the risks involved in rapidly reorganizing the economy—the lack of existing markets and uncertainty about how fast costs will come down—make it unattractive for financing by private lenders. This was especially true in the wake of the Great Depression but is true to some degree at any time. The third reason that major economic reorganizations require a more active role for the public sector is that some key industries or technologies simply may not exist. While private businesses are well-suited to finding commercial opportunities for existing technologies and for incrementally improving them, they have never been effective at basic research—and this becomes much more important in periods of rapid economic reorganization.

World War II offers clear examples of all of these problems. The war mobilization effort required a vast expansion and redirection of the country's productive capacity, even in areas where war production drew on existing industries and technologies, such as steel or shipbuilding. In other areas, such as aircraft, military production involved a qualitative as well as quantitative departure from prewar production. In other sectors, such as synthetic rubber and the atomic weapons program, the war

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<sup>4</sup> The classic discussion of this is Gerschenkron (1962). Alexander Hamilton's "Report on Manufactures" is one of the earliest proposals for what we would today call industrial policy, emphasizing the need for a strong federal government to guide the transition from agriculture to manufacturing.

effort required the creation of entirely new industries and technologies. All these factors pushed policymakers—sometimes against their own wishes—into adopting more centralized direction of the economy.

Problems like the climate crisis and future pandemics will involve an economic restructuring comparable in scale, if not speed, to the mobilization of World War II. It will similarly require a more active public sector role. In some areas, where carbon-free products and processes are already well-established, price signals in the form of a carbon price, or other taxes or subsidies, may be sufficient. But in many areas of the economy, we are likely to find that, just as in World War II, problems of coordination and uncertainty prevent the private sector from responding effectively to price signals, and a more active public role is required. In some key sectors where coordination problems are most severe, such as the electricity grid, the government may have to take direct responsibility for production decisions. In many other sectors, government will need to take responsibility for directing financing, even while production itself remains in private hands. Where basic research and the development of fundamentally new technologies are called for, much of this will have to be carried out by government directly.

## **THE PUBLIC SECTOR'S ECONOMIC ROLE IS MOST CRITICAL FOR INVESTMENT**

Despite a major role for direct public provision, the majority of production was carried out by private businesses operating on the usual criteria of profitability. But for a variety of reasons, private industries were in general unable or unwilling to carry out investment on the scale that was called for, and private banks were even more unwilling to finance it. Thus, the federal government had to take direct responsibility for building a major portion of the new factories and machines and had to finance most of those that were built by private industry. This was not a choice the administration made from the outset, but rather one that it was forced into by the failure of private business to respond to the incentive of wartime profits by expanding capacity on an adequate scale. This aspect of the wartime experience has important lessons for today: in particular, the deep-rooted weakness of private business in carrying out long-term investment, especially under conditions of uncertainty.

While some small steps had been taken to prepare the country for war, by early 1940, it became evident to the Roosevelt administration that the nation would have to do much more to prepare for the global emergency. After 20 years of isolationist peace and Great Depression austerity, the army found itself far behind German military capabilities. In contrast to 25,000 German planes, the US Air Corps had only 2,665 planes in the spring of 1940 (Civilian Production Administration 1947). Meeting Roosevelt's ambitious goals to make the US military not only competitive with the Axis powers but also able to support and subsidize its allies necessitated significant investment in specific sectors of the economy.

As described in the previous section, the federal government initially tried to increase capacity in war industries through various incentives for private investment and lending, before settling on direct public investment via the DPC. (The armed services also carried out some investment directly, outside of the DPC. In particular, there was a major expansion in navy-owned and operated shipyards, where the majority of ships used in the war were produced.)

In total, the federal government carried out about \$20 billion (\$285 billion in 2020 dollars) in new investment in war industries during the war—more than two-thirds of the total (Wilson 2016, 61–62). Table 1 shows the share of new plants and equipment accounted for by direct public investment during the war, by industry. Noteworthy here is not just the very large figures in many key industries, but the particular sectors in which the public role was largest. While several of these were purely military industries in which the armed services had long maintained their own production facilities, the others (uranium and plutonium, synthetic rubber, aircraft) were the newest, most technologically innovative sectors. This reinforces the critical role of the federal government in bearing the risk of investment, which is greatest in new industries.

**Table 1: Wartime Federal Investment by Industry**

WARTIME FEDERAL INVESTMENT BY INDUSTRY		
Industry	Federal investment (\$ billions)	% publicly owned, 1944-1945
Enriched uranium and plutonium	1.38	100
Shell and bomb loading	1.25	100
Synthetic rubber	0.70	97
Aircraft	3.43	89
Ships	2.19	87
Guns and ammunition	1.60	87
Nonferrous metals (aluminum, etc.)	1.72	58
Chemicals and explosives	2.26	43
Aviation fuel	0.25	33
Machine tools	0.15	26
Iron and steel	1.2	14

Source: Wilson (2016)



Of the 25 largest individual plants built during the war, 22 were built entirely with public funds; the remaining three were public-private joint ventures, with about 10 percent of the funds coming from the private sector (Wilson 2016, 64). And even this understates the public role in investment during the war. Almost all private investment during the war benefited in some way from federal support, whether through guaranteed orders as in the machine tool industry, loan guarantees to private banks, or other measures.

In decarbonization and in other crises, including the current coronavirus crisis, the same factors that limited private investment in war industries in the 1940s may persist. In particular, as Keynes famously observed, uncertainty about the future is a major, sometimes insuperable obstacle when businesses are considering major, irreversible capital outlays in periods of rapid change. Today, for example, we see hospitals choosing not to order urgently needed ventilators in response to the coronavirus crisis because they “can’t afford to increase inventory of expensive equipment for what could turn out to be a short-term event.”<sup>5</sup>

## **ONE OF THE MOST IMPORTANT STRENGTHS OF THE PUBLIC SECTOR IS ITS CAPACITY TO BEAR RISK**

*One of the main reasons the government had to take responsibility for investment during the war mobilization was that, even though military orders themselves were very profitable for contractors, there was great uncertainty about the length and scale of the war, the transition back to civilian production, and the contours of the peacetime economy that would follow it. This meant that the risks involved with long-run investment were greater than the private sector could bear. As the largest, longest-lived, financially strongest actor in the economy, the federal government has a unique capacity to bear risk, which needs to be utilized during periods of economic transition.*

Private businesses were understandably reluctant to commit to major expansions of capacity to meet military orders when it was far from clear how long the war would last or if there would still be demand for the products afterward. This was not a problem that private finance could solve. Only the federal government had the capacity to either insure against that risk—by guaranteeing sales and/or giving the contractor the option of retaining the plant after the war—or bear the risk itself by directly purchasing new plants and equipment. Since decarbonization will involve similar large expansions of capacity in industries without a proven track record, with substantial uncertainty about future returns, the government is likely to have to play a similar role in taking over risk that the private sector is unable or unwilling to bear.

Financing by the government was a matter of necessity in many war industries. War production was simply too risky a proposition for many firms and financiers. The size and novelty of production orders strained the resources and competency of firms. The uncertainty about the duration and nature of the

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<sup>5</sup> “More Lifesaving Ventilators Are Available. Hospitals Can’t Afford Them.” *Washington Post*, March 18, 2020.

war added further doubts and meant that the federal government needed to bear risks for firms and for lenders in order for production to be possible; the government developed a number of schemes to foster expanded capacity in war industries without the risks that private investment would have entailed for contractors.

As Koistinen (2004) emphasizes, what discouraged private investment, especially in established industries, was not a lack of funds, but a pervasive uncertainty about the future and a consequent aversion to risk:

Plant expansion met great resistance. Industry was not anxious to take up munitions production in 1940, for a number of reasons. Expanding capacity after a decade of depression was hazardous; civilian markets at home and abroad were growing; the outcome of the war in Europe was uncertain; and government contracts meant red tape and dealing with the New Deal enemy.

Many small firms, both independent firms and subsidiaries of large parent corporations looking to limit their liability in war production, found themselves with contracts for production and facilities far outside their usual purview. These contracts were often orders of magnitude larger than firms' net worth, with new and unfamiliar production processes in an environment of rising labor and other input costs.

Although commercial banks made liberal provision of credit for defense purposes [even in 1941], there was a considerable segment of the new munitions industry which clearly did not present bankable risks. A large number of small enterprises, in particular, found themselves with backlogs of orders utterly out of proportion to their net worth, and with production schedules and employment rising at a rate which made the maintenance of proper production and cost controls impossible. Frequently, the new orders were for types of production in which the manufacturer had had little or no experience (Fuller 1946, 117).

Going into the war, banking systems—particularly large New York banks—were flush with cash. Reserves in the US banking system had been inflated by gold inflows from an increasingly destabilized Europe. However, despite this, financing for war production was often difficult for firms to find. After a decade of depression and uncertainty, the appetite for risk was very low among financial decisionmakers. This tension was noted by the Federal Reserve in its annual report for 1938:

In view of the huge accumulation of idle funds there was an insistent demand for the highest grade investments, corporate as well as governmental, but the flow of funds into new investments of a character involving any appreciable degree of risk, such as the lower grade corporation bonds and stocks, remained limited (11).

Similar conditions apply to some extent today. In the aggregate, credit markets have abundant liquidity, as evidenced by extremely low market rates and large amounts of debt issued by

established borrowers. But the demand from finance is primarily for extremely safe, liquid assets, as evidenced by the low or even negative rates on the safest government debt. Smaller businesses may still be rationed in their access to loans, or in some cases shut out of credit markets entirely. Smaller businesses that are able to borrow freely are often only able to do so because the public sector takes on much of the risk through the Small Business Administration loan guarantee program. And most businesses, despite strong profits and extremely cheap credit, are wary of any investment that will not pay for itself in a short period—perhaps as short as a year.

White (1949) describes the same pervasive fear of risk from the perspective of private bankers:

Private capital, while yearning for new opportunities for investment after the depression years, [was] understandably timid at the prospect of investment in defense industries because of the risk involved. The sense of risk may well have been heightened by the long period of friction between the New Deal and the financial community. Only if this risk could be offset by substantial inducements was private capital likely to be available for defense financing . . . (159–160)

What is striking about this is that profits in defense industries were consistently high, and credit losses on loans to war industries were negligible.<sup>6</sup> But because of the forward-looking nature of investment, these very favorable current conditions were rarely enough to make private businesses or banks willing to bear the risks associated with long-term investment. This is a clear illustration of the critical importance of confidence in the future, which can dominate current market signals.

Returns that are uncertain or far off, even if they are likely to end up being quite high, may be unacceptable to private investors, especially if—as with major new investment—there is the need for substantial financial commitment at the outset. The possibility of losses on particular projects is much less of a problem for the public sector—provided that public officials are willing to tolerate them. This was a problem that wartime policymakers had to continuously struggle with.

Today, as during World War II, it may be necessary to set up institutional structures that can tolerate a significant number of failures if the public sector’s risk-bearing capacity is going to be mobilized for the efforts against the coronavirus and the climate crisis. Losses on loan guarantee programs may be low, but it is critically important that they are not zero. Risk-bearing by the federal government requires that the government actually shoulder some risk. If none of the projects financed by the federal government fails or defaults, that means it isn’t doing so.

In the US, despite record-high profits and record-low interest rates, which should lead to an investment boom, corporate investment is near historically average levels. This suggests that the role of the public sector as ultimate economic risk-bearer is not obsolete. In the transition to a green

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<sup>6</sup> As Wilson (2010) notes, the cost-plus structure of military contracts meant that it was not generally possible for contractors to enjoy extraordinary windfall profits, especially after the passage of a 1942 law requiring compulsory renegotiation of contracts when profits were higher than anticipated. By the same token, however, some profit on military contracts was effectively guaranteed.

economy, in response to pandemics, and in any other major transition involving major new technologies and new ways of working, often pioneered by smaller businesses and startups, the role of the public sector as risk-bearer will once again be critical.

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