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THE AMERICAN PARADOX: IDEOLOGY OF FREE MARKETS AND PRACTICE OF DIRECTIONAL THRUST

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ABSTRACT:

The United States presents a paradox. The US state has practiced production-focused industrial policy from the early years of the Republic, with benefits that by any plausible measure far exceed costs. But since the 1980s the exchange-focused idea that "the free market is what works, and having the state help it is usually a contradiction in terms" has been at the normative center of gravity in public policy discourse. "Industrial policy" has been toxic. So since the 1980s the state has disguised its production-focused practice, to the point where even non-ideological academic researchers claim that the US does industrial policy not at all, or badly. This essay reviews the history of US industrial policy, with an emphasis on "network-building industrial policy" over the past two decades. At the end it draws a lesson for policy communities in other countries and in inter-state development organizations like the World Bank and the IMF.

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Key words: industrial policy, US developmental state, networks, varieties of capitalism, leading the market, following the market

JEL classification: H54, L5, L6, N62, O25

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"The most innovative entrepreneur in the 20th century was the U.S. government" (Michael Lind, author of *Land of Promise: An Economic History of the United States*)

"The best American industrial policy is to convince the world that America has no (effective) industrial policy" (quip among heterodox economists)

"The present round of industrial policy will no doubt produce some modest successes – and a crop of whopping failures" (*The Economist*, 5 August 2010)

. . . . . .

For the past eight decades the American political debate – as in much of the West – has been structured around the size and scope of government. Republicans want less government and more "liberty", Democrats want more government and more "equity", broadly speaking. The economic crisis of the 1970s, followed by the election of Ronald Reagan, ushered in what turned out to be a durable shift of the normative center of gravity towards "smaller and narrower government". Declarations like, "The free market is what works, and having the state help it is usually a contradiction in terms", set heads nodding in agreement (Kasperov 2012: 6). [1] Following the crisis of 2008 a prominent libertarian funder announced that the United States was "facing the greatest loss of liberty and prosperity since the 1930s", due to the Obama administration's new regulations, public works programs and government agencies (Koch, 2009). Newt Gingrich, Speaker of the House of Representatives from 1995 to 1999 and thereby second in the presidential line of succession after the Vice President, told readers of his 2010 book, *To Save America*, that the Obama administration "represents as great a threat to America as Nazi Germany or the Soviet Union once did" (Gingrich, 2010). [2]

[1] In this vein, Jacquelyn Brechtel Clarkson, a New Orleans city councilor, saw "nothing better than free enterprise and the free market to decide how this city is rebuilt" following the devastating floods there (quoted in the *Financial Times*, 10 January 2006).

[2] For an account of how billionaires and their organizations push the American intellectual climate to the radical right, including via the ideological production line of think-tanks and university endowments, see Mayer, 2016.

These statements come from the right-wing of the spectrum, but their view of government exerts a gravitational pull across American public policy and academic economics. So "industrial policy" is widely understood as "porkbarrel politics", "rent-seeking", "corporate welfare", "crowding out private enterprise" and "picking winners". It is seen as a Trojan Horse for distortionary government intervention that corrodes the values of an entrepreneurial culture, undermines the efficacy of market competition and stacks the incentive system in favour of one or other rent-seeking groups. "Governments cannot pick winners, but losers can pick governments". [3]

A study of US industrial policy for biotech concluded:

"The knowledge economy [in biotech] did not spontaneously emerge from the bottom up, but was prompted by a top-down *stealth industrial policy*; government and industry leaders simultaneously advocated government intervention to foster the development of the biotechnology industry and argued hypocritically that government should let the free market work" (Vallas et al., 2011, emphasis added).

When official bodies do endorse industrial policies – though they rarely use this phrase – they invoke the justification of "market failures". The international market, not government, should set the directional signals for investment, except where markets fail in some sense and where the benefits of "intervention" are very likely to exceed the costs. So the central recommendation of the President's Council of Advisors on Science and Technology's June 2011 report on manufacturing explained that the core challenge in reviving US manufacturing was to "overcome market failures". The Department of Commerce's June 2012 report on "U.S. competitiveness and innovation capacity" also suggested that the government's core role is to correct market failures and provide an environment

[3] This essay is one of several about industrial policy by the same author: for example, Wade, 2004, 2010, 2012, 2016

conducive to innovation-in-general via tax policy and patent law (Department of Commerce, 2012).

In March 2012 Gene Sperling, director of the White House's national economic council, declared that a national manufacturing renaissance would be strongly in America's interest (Sperling, 2012) . His speech was notable for two reasons. First, it was the first time that a key figure in the Obama administration – or for that matter in any of the past several administrations – spoke positively of manufacturing and the need to mount industrial policies to help the sector. Second, the speech disappeared without trace.

Here is the American paradox. On the one hand, the "market fundamentalist" narrative has long dominated public policy discourse, drawing affirmation not only from neoclassical economic theory, but also from its elision of "market forces" with beyond-question values like "freedom", "democracy", "meritocracy", "self-reliance", "the God-designed, natural order", and its elision of "government intervention" with "economic sclerosis", "the nanny state", "the road to serfdom". In this narrative the US does little by way of industrial policy, and what it does is mostly ineffective or harmful. So the fact that the US continues to lead the world in industrial and military innovation is apparently unrelated to selective government programs.

On the other hand, the government has in fact undertaken much more industrial policy than the standard narrative says, from the founding of the Republic till today. Its efforts have ranged from promoting what became major technological innovations ("general purpose technologies"), to specific sector applications and products, to -- at the nudging end -- manufacturing extension services similar to agricultural extension services (Block and Keller [eds.], 2011, Weiss, 2014). In some sectors some of the time, the government has "led the market", taking initiatives the private sector would not do unaided

(this is sometimes called "mission-oriented" industrial policy). In some sectors some of the time, the government has "followed the market", placing bets on *some* of the investments private firms were already undertaking. The government has also mounted "horizontal industrial policy" to boost certain functions without discrimination between sectors, such as special credit lines for small and medium enterprises or subsidies for R&D (Wade, 1990).

In response to the legitimacy of the market fundamentalist narrative, agencies involved in industrial policy in the past two to three decades have gone out of their way to keep their programs off the radar of public (and academic) attention. The eclipse has been so effective that it is not generally known that a US government agency's program spawned the Internet. The rate of return on the publicly-funded part of this one innovation must be high enough to offset by far whatever "mistakes" the government made elsewhere by way of "government intervention".

Or take the case of Apple, whose narrative attributes its success to Steve Jobs and his credo "Stay hungry, stay foolish". In fact, as Mariana Mazzucato says, "the genius and 'foolishness' of Steve Jobs led to massive profits and success, largely because Apple [whose R&D to sales ratio over 2006 – 2011 put it in the *bottom three among 13 of its top rivals*] was able to ride the wave of massive State investments in the 'revolutionary' technologies that underpinned the iPhone and iPad: the Internet, GPS, touch-screen displays and communication technologies. Without these publicly funded technologies, there would have been no wave to foolishly surf" (Mazzucato 2013, 88).

The American hostility to industrial policy fed into global hostility through inter-state organizations such as the World Bank, the IMF and the OECD. Western-governed development organizations turned away from the idea of development as the expansion of *production* capabilities (including industrialization) and emphasised development as the expansion of *exchange* ("the

market"), coupled with targeted measures to reduce poverty. When Justin Yifu Lin became chief economist of the World Bank in 2008 (the first-ever non-G7 chief economist) he tried to promote interest in a modest kind of *production*-focused policy ("industrial policy"), in which a government promotes selected industries while staying within the economy's *existing* comparative advantage. Virtually none of the regional vice-presidents were interested in mounting pilot projects, and the whole idea was dismissed by a senior economist in Lin's own research department, "For every Korea there are a hundred failures. Who would you put your money on?" (personal communication).

The global hostility to industrial policy draws strength from the – mistaken -- belief that the US does not do industrial policy.

The first section below gives a galloping history of U.S. industrial policy from the first years of the Republic through the nineteenth and twentieth centuries.

The second section describes the prevailing arguments which have served to delegitimize industrial policy during the past two to three decades.

Section three builds on the point that some people and some parts of the US state are alarmed by the way that financial deregulation has placed business managers under more shareholder and bonus pressure than ever before, resulting in managers *cutting* investment in basic technologies in order to focus on short-term "value extraction", relying on *public* agencies for basic research and pre-commercialization. Some public officials are also alarmed by the way that managers of high-tech "start-ups" commonly shift "scale-ups" overseas to cheap labor sites, limiting the growth of manufacturing jobs and eroding innovation at home (which depends on a close link with *production*, future capabilities being path-dependent on existing capabilities).

In response, the US has established, without coherent design, a "developmental state" in disguise, distinctly different from the East Asian kind. Government agencies, at federal and state levels, have attempted to lead low-visibility networks of suppliers, subcontractors, middlemen, venture capitalists, laboratories, and universities, in order to (1) accelerate the move from technological breakthrough to commercial products, and (2) supply themselves with frontier products and services they need for their own mission. This could be called "network industrial policy". However, it is much easier said than done, because networks between competing firms tend to be fragile and prone to break-up on account of Prisoners' Dilemma incentives.

Section four gives examples of successful recent network industrial policy, referring to the Defence Advanced Research Projects Agency and its SEMATECH advanced semiconductor equipment manufacturer, public-sector (including CIA) venture capital funds, and the Advanced Technology Program.

Section five describes some cases of relative failure drawn from the energy field, compared with corresponding successes in Denmark and Japan.

Section six offers a broad assessment of effectiveness.

The last section summarizes the argument about the disjunction between the ideology of free markets, which places the expansion of "exchange" at the center of public policy, and the practice of boosting "production" capabilities in high-tech sectors. It indicates some directions of change to make US industrial policy more effective, and draws a lesson for the policy community in other countries, including developing countries.

The discussion uses "industrial policy" to cover the whole value chain involved in making things, including the services of scientists and engineers who design and test the things – the

medical pills, the automobiles, the smart phones, and the rest -- whose actual manufacturing may be abroad. What differentiates industrial policy from other policy is that it is necessarily selective between industries, products, and stages of the value chain.

I. The first two centuries of the US developmental state

Fighting and preparing to fight wars spurred American innovation and economic growth from the beginning, as also for continental European countries and pre-British Indian states. Alexander Hamilton, the first Treasury Secretary, outlined a strategy for promoting American manufacturing, with the aim of catching up with British manufacturing and providing the base for a strong military. Published in 1791 and called *Report on Manufactures*, it championed not just tariffs, but also the strategic use of subsidies, tariff drawbacks on imported inputs used for exports, export bans on key raw materials, public procurement, product standards, and immigration (O'Sullivan et al, 2013). George Washington, the first president, supported the plan. Also, from the first years of the Republic the government invested in technological expertise for military purposes. It created the Army Corps of Engineers in 1802 and put army engineers to work building canals and lighthouses and improving river navigation.

Later, Abraham Lincoln presided over what was by then called "The American System" for promoting increases in income and wealth, using high tariffs to protect strategic industries, federal land grants, government procurement to secure markets and subsidies to infrastructure development. Lincoln launched the building of the transcontinental railway in the 1860s, probably the most ambitious civil engineering project in world history to that time, linking the established agro-industrial bloc with the emerging engineering bloc. Federal- and state- supported R&D started in agriculture in the 1860s. Agencies at both levels used public authority and resources to build links between education establishments and dedicated civil servants and scientists in

areas such as animal husbandry, agricultural chemistry, forestry and mining.

All through the nineteenth and early twentieth centuries US industrialization proceeded behind average applied industrial tariffs exceeding 30% up to the 1930s, justified by ideas articulated in Hamilton's *Report on Manufactures* (Kozul-Wright, 1995). Here the US was doing the same as other countries engaged in catch-up to the leading countries, except that its trade protection was among the most generous. Like these others, the US scaled protection down as its firms became internationally competitive. Then from the 1970s the US and other western countries created a trade regime which forced other countries to cut protection to low levels as a condition of access to their markets, justified with the argument that expanding exchange was the best way to boost production capacities.

From the turn of the twentieth century US government procurement, the provision of formal scientific training in public organizations, and product and process standards proved critical for establishing and enlarging mass-market industries. Early in the twentieth century the federal government used airmail fees to subsidize the infant civil aviation industry. It used public procurement to establish an early aircraft industry and advanced chemical sector. Its commitment to agricultural research and engineering training expanded after World War One through such initiatives as the Adam Act and public laboratories committed to applied experimentation and upgrading (Nelson and Wright, 1992). The government was also heavily involved in establishing the Radio Corporation of America (RCA), which sponsored radio and TV networks.

The New Deal provided the context for a more concerted US industrial policy involving efforts not only to ensure industrial recovery from the Great Depression but also to change the way business behaved and help increasingly large firms to operate more efficiently. Doing so involved new institutions, norms and

rules to administer prices, to boost dialogue among the various stakeholders, to provide public infrastructure and curtail the power of finance. These efforts were often contested and their impact uneven (Blyth 2002, Badger 2008) .

The most visible form of a developmental industrial policy was the Tennessee Valley Authority (TVA) established in May 1933. The TVA was conceived as a development agency, mandated to raise living standards in the impoverished Tennessee River Valley, and also as a construction and management agency mandated to build and operate dams and structures along the Tennessee River, whose drainage basin over seven states covers some 40,900 square miles (105,930 square kilometres). The TVA was to function, in Roosevelt's words, as "a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise". Over the 12-year period spanning its inception in 1933 and the end of Second World War in 1945, TVA established its institutional framework, built broad-based local support for its programmes, and constructed a physical infrastructure that would serve as the backbone for its accomplishments. By triggering an increase in the rates of return to private investment in the southern US states, the infusion of public capital through the TVA sped up post-war industrialization of the southern economy.

The US military undertook an overarching national planning project as it geared up to enter World War Two. General George Marshall commissioned the preparation of the Victory Plan of 1941. It planned "the future organization of an army that did not exist, outlined combat missions for a war not yet declared, and computed war production requirements for industries that were still committed to peacetime manufacture" (Kirkpatrick, 1990).

The war-time government-military-industrial complex went on subsequently to launch a series of mission-oriented projects which yielded fundamental innovations, including the atomic

bomb, the hydrogen bomb, missile technology, civilian nuclear power, computers, the transistor, preparatory work on the laser, space rockets and satellites. The dominant approach to selective industrial policy took the form of government support for a plethora of military laboratories in "basic" research, coupled with long-term public procurement contracts with big-name military firms, as well as subsidies, investment guarantees and bailout measures. Hence the quip, "America has had three types of industrial policy: first, World War Two, second, the Korean War, and third, the Vietnam War". The focus on "basic" and "military" avoided the ideological issues around industrial policy, because even market fundamentalists accepted that government *should* fund the development of new weapons and intelligence systems.

Those opposed to "state intervention" tend to airbrush this extensive history away, and claim that from the founding of the Republic to the start of the Roosevelt's New Deal in the 1930s the US grew fast in the context of a state which limited its economic role to providing an institutional "level playing field" framework for markets. They further claim that the US then took a wrong turn at the time of the New Deal towards excessive state intervention.[4] The election of Ronald Reagan as president in 1980 did much to revive this simplistic narrative of "the government is the problem, not the solution".

Michael Lind, author of *Land of Promise: An Economic History of the United States*, summarizes:

"The most innovative entrepreneur in the 20th century was the U.S. government. The federal government invented or developed nuclear energy, computers, the Internet and the jet engine. And it built the interstate highway system and the completed the national electric grid, creating a continental market based on the technologies of the second industrial revolution. To be sure, the

[4] While some prominent Americans in the fledgling international organizations established at the end of the Second World War came from the New Deal tradition, the first cohorts of Americans in senior positions at the World Bank through the 1940s and 1950s tended to be strongly anti-state and anti-New Deal. The powerful first vice-president, Robert Garner, declared in his 1972 memoir, "Roosevelt … did more harm to this country than anyone else in history". Quoted in Alacevich, 2009, at 32.

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. Indeed, venture capitalists in IT and social networking have exploited and commercialized technologies from the transistor to the Internet that were originally developed by America's home-grown version of state capitalism" (Lind, 2012).

II. Industrial policy becomes toxic

Through the 1980s and later mainstream economists declared themselves sure that industrial policy is a bad idea. According to Gary Becker, who was awarded the Bank of Sweden Prize in Economic Science in Memory of Alfred Nobel, "The best industrial policy is none at all" (Becker, 1985). The distinguished development economist John Williamson, coiner of the phrase "the Washington Consensus", said, "Little in the record of industrial policy suggests that the state is very good at 'picking winners'" (Williamson, 2012, 10). Lawrence Summers -- a prominent public intellectual in the United States, professor economics at Harvard, former US Treasury Secretary and former chief economist of the World Bank – declared that government "is a crappy VC [venture capitalist]" (quoted in Nocera, 2011).

A British economist, Tim Leunig of the London School of Economics, echoed back:

"The government should be providing conditions that help all businesses – namely, effective infrastructure, a skilled workforce and better planning. We should make no attempt to pick winners – whether individual companies, specific sectors, or manufacturing as a whole" (Leunig 2010, 14).

Commentating on the state of opinion among mainstream economists, Michael Lind says, "It would be easy to get a thousand Ph.D economists [trained in the Anglo-American

milieu] to sign a manifesto insisting that we should ignore history whenever it conflicts with theory… about generic firms competing in abstract markets" (Lind 2012). [5]

Mainstream economists rest their "should" on theoretical ideas like Kenneth Arrow and Gerard Debreu's First Fundamental Theorem of welfare economics, as well as the "market generally works best" ideology which suffuses university teaching in economics. But in fact, the theory is ambiguous. The First Fundamental Theorem states that markets are the most efficient resource allocators when: (1) there is a complete set of markets with publicly-known prices; (2) consumers and producers are price-takers and in that sense behave competitively; (3) an equilibrium exists. These conditions make a castle in the sky. To the extent they are not met the theorem does not provide theoretical grounds against industrial policy.

The empirical evidence is also inconclusive, because of the difficulty of finding cases with an exogenous source of variation with which to test causality "rigorously". So we are left mostly with correlations between policies and outcomes, which can always be disputed. In the face of inconclusive theory and empirics and an ideological current in the opposite direction, few "top" economists are drawn to work on industrial policy and few "top" economics journals publish papers about industrial policy.

Analysts with a more political perspective come to broadly the same conclusion against industrial policy in the US and other Anglo countries, based on an analysis of what works and does not work in certain varieties of capitalism.

[5] The "Anglo-American milieu" in economics spans most economics teaching in Europe and the Americas, and much of the rest of the world as well. For its deep penetration in the Republic of Georgia, and specifically the deep penetration of Gregory Mankiw's *Principles of Economics*, see Wade 2016b.

The political economists Peter Hall and David Soskice have no ideological agenda against "government" and for "markets". Rather, they argue that the shape of state-market institutions in the US, also the UK, is such that industrial policy is unlikely to be effective in improving on market outcomes when judged by a national interest test.

Advanced capitalist economies, they argue , tend to cluster with little hybridity into one of two types at the national level: the "liberal market economy" (LME), exemplified by the US and UK, and the "coordinated market economy" (CME), exemplified by Germany and Japan. Firms in LMEs coordinate their activities mainly through the institutions of markets and hierarchies, and tend to invest in "switchable assets" (which allow rapid entry and exit). Firms in CMEs coordinate relatively more through institutions which support ongoing cooperation, encourage credible commitments and exchange of information, and "provide actors potentially able to cooperate with one another with a capacity for deliberation" (Hall and Soskice, 2001, 11). Examples of such institutions include business associations, trade unions, cross-shareholding networks, and legal systems that facilitate information sharing.

Hall and Soskice and others in the "varieties of capitalism" school argue that industrial policy is more likely to be effective in CMEs than in LMEs, because of the weakness of institutional support in the latter. For the US, specifically, they argue that industrial policy is further hobbled by two fundamental political features: (1) strong separation of powers between the executive, legislature and judiciary; and (2) strong separation of powers between the federal, state and local levels.

The sociologist Michael Mann agrees:

"*There is no serious American industrial policy*; this is left to the post-war powerhouses of the US economy, the large corporations. Much of this [industrial policy failure] is due to the radical

separation of powers enshrined in the US constitution. A coordinated political economy cannot easily be run by a President and his cabinet, two Houses of Congress, a Supreme Court and fifty 'states' (which are also fragmented by the same separation of powers) – especially when they belong to different political parties" (Mann, 1997, 484, emphasis added).

In these conditions the US and other LME governments may practice what is sometimes called industrial policy; but it is uncoordinated and yields negative net welfare gains, as vested interests capture the relevant parts of the state apparatus and sluice resources in their favour. Kevin Philips goes so far as to say that industrial policy in a fragmented political structure like the US is both "inevitable and ineffective" (Philips, 1992, 104). Frank Dobbin reports that the conventional wisdom in political sociology is that "American state structure is better suited to inchoate, misguided bailouts characterized by political graft than to coherent, disinterested, planning on the Japanese model" (Dobbins 1993, 251).

Yet it is generally accepted that no other country comes close to America's capacity to reinvent itself through technology. Think of inventions like aircraft, automobiles, the computer, and the Internet. In the past decade US companies like Apple and Google battered Canada's RIM and Finland's Nokia in smartphones. Its companies launched 4G services well before others, having been far behind Europe in launching 3G in 2005. In energy, small companies like Devon Energy and Chesapeake (not the global oil majors) have developed commercially viable hydraulic fracking technology, sharply reducing US dependence on imports of oil and liquefied natural gas (Gapper, 2012).

So the common argument says that (1) the US has remained on the frontiers of world technology for many decades, (2) it has not used industrial policy, or if so, only on a small scale (hence the inevitable rent-seeking costs to society have been kept small),

(3) other countries should not try industrial policy -- as distinct from improving the overall business and science environment, and especially, expanding the scope for exchange.

III. Emergence of the network developmental state

What follows is the story which most economists and commentators on the US economy miss.

Through the decades of industrial policy under the military umbrella the government assumed that "the market" would transform the results of military-related R&D more or less automatically into commercial innovations in civilian industry. By the 1980s a narrow circle of scientists, business school academics and technology policy officials realized that military-related technologies were being carried into commercial applications only patchily; and that, partly for this reason, US industrialists were being outcompeted across a swathe of high-tech industry by Japanese and German firms. Between basic research outputs and commercial products lurked the "valley of death", where potential products languished for want of private sector uptake (Scott and Lodge, 1985).

In response, agencies like the Department of Defence (responsible for about half of federal R&D spending over the 2000s), the Department of Energy and the National Institutes of Health, decided to act – with the aims, first, to accelerate the move "from R to D", from technological breakthroughs to commercial products ("following the market"), and second, to incentivize the private sector to develop latest-generation products which the agencies themselves wanted for their own work ("leading the market").

Yet all the while the problems mounted: military research did not spill over into civilian uses "by itself" (by the market); Japan and Germany provided tough competition; the US trade

surplus in technologically sophisticated products (which helped to offset growing deficits for raw materials and basic manufactured goods) shrank.

Government officials began to formulate the general strategy on the basis of the success, through the 1970s, of the Defence Department's Defence Advanced Research Projects Agency (DARPA) in channelling vast federal funds for coordinated R&D at the Lawrence Livermore National Laboratory and the universities of Stanford and California at Berkeley, co-located within a couple of hours' drive of each other. Private spin-off firms from these programs then helped to turn Silicon Valley from orchards into the planetary center of innovation in computing.

The public officials also drew inspiration from developments in biotechnology in the 1970s, notably the birth of Genentech in 1976, which showed how government agencies could help university-based scientists establish successful firms.

In the subsequent decades many government agencies, at national, state, and even city level have funded R&D in selected sectors. At national level the agencies include Department of Defence, DARPA, ARPA-E (Advanced Research Projects Agency-Energy), Department of Energy, National Institutes of Health (NIH), National Institute of Standards and Technology (NIST), Small Business Administration (SBA), National Science Foundation (NSF), National Aeronautics and Space Administration, and more.

There is no powerful coordinating center equivalent to Japan's tripos of MITI, the Economic Planning Agency, and the Ministry of Finance during the post-war catch-up decades; or counterparts in Taiwan and South Korea (Johnson, 1982; Overseas Economic Cooperation Fund, 1995). But a degree of coordination comes through a multitude of apex advisory bodies. A prime example is the Presidential Council of Advisors on

Science and Technology (PCAST), established in 1990 in a line of descent from the Science Advisory Board established by Franklin Roosevelt. Reporting directly to the President and administered by the Office of Science and Technology, it currently comprises 18 distinguished individuals from industry, education, and research institutes. Recent reports deal with antibiotic resistance, educational technology, cybersecurity, climate change, information technology and agricultural preparedness. Working with it recently has been the Advanced Manufacturing Partnership, another advisory council targeting advanced sensing, digital manufacturing and advanced materials.

At the operational level, epochal changes in the structure of production over the past three decades have prompted changes in *how* agencies intervene. Before 1980 large firms internalised most of their activities and met the rest through arms-length relations in more or less competitive markets. Government agencies could contract with individual large firms in a bilateral manner. Since then, production has become more decentralized, both geographically and organizationally. In the more decentralized structure, firms and other participants sometimes establish, on their own, trusting, reciprocal "network" relations with duration over time, modifying arms-length relations. However, "self-starting" networks tend to be fragile and prone to break-up due to Prisoners' Dilemma incentives. Network steering public agencies help to offset the tendency for private actors to defect from networks, exit basic research and scale-up overseas.

For example, the National Institute of Standards and Technology (NIST) organizes Manufacturing Extension Partnerships through MEP centers in all 50 states. The program was started in 1988 in response to Japanese manufacturing competition in consumer electronics, steel and other industries. It targets mainly smaller US-based firms, providing them with technical, marketing and financial advice, as well as training; and in some cases encouraging them to cooperate in joint R&D projects. The centers are financed by a combination of federal,

state and local government grants, and client fees. The program received a doubling of its budget after the 2008 crisis.

The centers provide services via "direct delivery" and "brokerage". In direct delivery mode, a center sends one or more of its own experts to a firm to advise how to improve lean production or quality control, and how to find new clients; and it might bring firms together to explore network possibilities. In brokerage mode, the center acts more indirectly, arranging private consultants to do much the same things. Andrew Schrank finds that centers headed by engineers tend to emphasise direct delivery, those headed by MBAs tend to do brokerage. He also finds that "Both models work, in the sense of providing high rates of return – the costs of MEP centers are low, and there's lots of low hanging fruit out there in the US" (personal communication, and Schrank, forthcoming).

Other noteworthy initiatives come from the Small Business Administration (SBA), which makes Small Business Innovation Research (SBIR) grants. Federal agencies with large research budgets (like NIH and the Department of Energy) are required to allocate 2.5% of grants to the SBA, which in turn distributes about 5,000 awards to 1,500 small firms per year. These awards are especially important in bridging university and commerce; for example, in recent years more than two thirds of the recipients include an academic or former academic among their founders.

Industrial policy, by other names, received a big boost as part of the countercyclical policy response to the Crash of 2008 and ensuing Great Recession, which blunted the normal political opposition. The American Recovery and Reinvestment Act (ARRA) of 2009 supported an integrated package, including tax cuts for low- and middle-income Americans and for small businesses, assistance for the auto industry (eg Chrysler, General Motors), large-scale investment in science, technology, engineering, and maths (STEM) education, in the health industries, in clean energy/batteries/advanced materials, and in

infrastructure for communications, transportation and energy. However, note that the assistance to the auto industry was relatively small and condition-laden compared to favoured *financial* firms which received vast public money largely free of conditions. Both Chrysler and GM had to file for Chapter 11 bankruptcy protection and emerged with new owners.

ARRA was further boosted after 2010 by several manufacturing-focused initiatives, including the National Network for Manufacturing Innovation (NNMI), Materials Genome Initiative, and Robotics Center. Inshoring manufacturing production received a 20% income tax credit. The 2010 National Export Initiative boosted support for exporters.

The ARRA was just one program among several stimulus programs in response to the 2008 crash. By 2010, with the economy still close to recession, the Republicans, backed by billionaire financiers and their think-tanks, had regrouped sufficiently to persuade a voting majority in the midterm elections that federal spending and government regulation were the barriers to private sector economic growth. Now back in control of the House of Representatives, Republicans cut the budgets for the stimulus programs, including industrial policies, in the time-honoured way.

IV. Network industrial policy successes

The following three case studies of success stories help to illustrate the specific conditions, policies and mechanisms that fostered the emergence of state-guided networks. [6]

DARPA and SEMATECH

[6] In addition to the factors mentioned below, competition between US states and cities for talent and resources probably helps to make network industrial policy more effective. US states benefit, both fiscally and politically, from their successes and suffer from their failures. In the UK, by contrast, public spending and planning is more centrally controlled, and local benefits and losses are more absorbed into the national treasury.

The Defence Advanced Research Projects Agency, DARPA (from time to time the D has been dropped), was founded in 1958, in response to the Soviet sputnik. Since then it has been a leading stimulator of technological innovation in -- amongst many things-- computers, computer languages, and semi-conductors. For example, it was the earlier-mentioned agency which sponsored the research on how to build robust and dispersed computer networks, which led on to the "network of computer networks" we know as the Internet. Recently it has been stimulating research into a priority area where private R&D was lagging: optical interconnects in multicore microprocessors.

Though DARPA is tiny (around 250 staff, of whom 140 are technical) and though it concentrates on over-the-horizon research, it still has to fend off "pork barrel", "picking winners" and "crony capitalism" attacks from market fundamentalists and techno-utopians arguing that philanthropists plus the three billion people coming online together constitute adequate self-organizing innovation systems (see for example Diamandis, 2012).

One of DARPA's many successes is SEMATECH, a famous example of network-building industrial policy. DARPA and the semiconductor industry association prompted the creation of the SEMATECH consortium in 1987, in response to the virtual disappearance of American companies able to make the equipment needed to make latest-generation semi-conductors. The leading equipment makers were by then Japanese, who tended to hold back the latest-generation equipment for six months of "testing" by Japanese semi-conductor makers, giving the latter a strong competitive advantage over American rivals. DARPA and the semiconductor industry association persuaded fourteen American semi-conductor makers to form a consortium to pool R&D and manufacturing capacities and re-enter the design and production of advanced semi-conductor-making

equipment. The Department of Defence (DARPA's parent) funded the first five years.

In the early years the consortium was fragile, especially when the semiconductor price cycle was up and the companies were making good profits; then they hesitated to send top-notch people to work for the consortium. DARPA's stewardship (funding and close collaboration at the *technical* level where its suggestions would be most appreciated) helped to overcome collaborators' fears of either "getting screwed" by other collaborators' non-reciprocity or opportunism, or having their collaborators "screw up" through incompetence. By 1994 it was well enough established that its board stopped further federal funding. It flourishes to this day.

Public venture capital (VC) funds, pioneered by the CIA

Since the late 1990s many US government agencies have established VC funds. Though inspired by Silicon Valley venture capitalists, the public funds are not to make money, but to enable the agency to induce the development and adaptation of commercially viable technologies for agency needs. The funds make equity investments in (mainly) small and medium technology companies and play a hands-on role in those firms, at the same time helping to link firms together where the officials see complementarities. By highlighting their co-partner role with private sector financiers and their dedication to market mechanisms they are able to fend off attacks by market fundamentalists.

Surprisingly, the origin of the federal agencies' VC funds was a traditionally secretive and insular agency, the CIA. It established a VC arm, called In-Q-Tel, in 1999, in order to overcome the problem that traditional government procurement practices (established in a slower-moving technology era) meant it had to procure from large established companies which

themselves sourced many of their technologies from SMEs. The result was that the CIA often obtained technologies with a long delay, by which time they were no longer cutting-edge; and that the products did not match the agency's specific operational needs. With its own VC fund the CIA could invest in nimble SMEs directly and get them to do its bidding.

Over the 2000s the federal VC model proliferated. The Army and the Navy, for example, both established VC funds. Non-military agencies did the same: for example, the Department of Energy established several; and NASA participated with a private non-profit VC fund. Matthew Keller summarizes:

"Public sector venture capital strategies rapidly became broadly accepted tools for spurring mission-oriented technical innovation and/or to transform government research into commercial products" (Keller 2011, 126).

The Advanced Technology Program and the hazards of visibility

About the most visible segment of the US state's efforts to promote technological innovation was the Advanced Technology Program (ATP). The fate of the ATP illustrates what can happen when a hidden developmental state becomes visible in a polity gripped by market fundamentalism (Negoita, 2011).

ATP was created by the National Institute of Standards and Technology (NIST), within the Department of Commerce, in 1988, in response to the earlier-mentioned fears of surging Japanese competition in high-tech. It could be thought of as a civilian counterpart to DARPA. It developed strong connections to industry and academia, to stimulate the early stages of advanced technologies that would not get private funding.

By many measures it was very successful. For example, firms whose R&D received ATP funding had a 50% shorter research cycle time than firms which applied to ATP for funding

but did not get it – giving the lie to the accusation that taxpayers' money was being used to fund early-stage R&D which the firms would have done anyway. Second, participants in ATP-sponsored projects said that ATP participation generated a higher level of collaboration with other firms than would have occurred otherwise. Third, a slew of new products came out of ATP programs: for example, small disc drives (which paved the way for multibillion dollar markets in consumer electronics, such as the iPod), also flat panels and plant-based biodegradable plastics.

It did not hide its light under a barrel. Seeing a high profile "government intervention", market fundamentalists targeted the ATP from 1994 onwards. Operating through the House of Representatives, they continually cut its budget, to the point where in 2007 the Bush administration and the Republican Congress succeeded in axing it.

V. Network industrial policy failures

Photovoltaic energy systems

The case of solar photovoltaic (PV) energy systems illustrates that the success or failure of network industrial policy should not be judged only from the supply side (Knight 2011). As Schumpeter said, the technology pipeline consists of invention, innovation and diffusion; or in later language, research, development and deployment. The US federal government played a vital role in making US-based networks of public and private actors the world's leading source of PV inventions and innovations, starting in the 1970s.

But it mounted no corresponding federal program to accelerate *deployment* of the innovations in public use; and state programs (for example, subsidies and feed-in tariffs) have been bitty and widely varying from state to state. Germany, Japan, and

Spain all raced ahead in installed capacity per capita. A recent report on national policies supporting solar PV deployment ranked the US fifth, behind Germany, France, Greece, and Italy.

The basic reason for the mismatch between R&D, on the one hand, and deployment on the other, may be that the US has a more "locked-in" energy system than countries that have gone further with PV installation, with stronger lobbies defending fossil fuel generation. Hence politicians are willing to allocate funds for PV R&D but not for deployment, which might displace valued sources of campaign finance (the fossil fuel and nuclear industries). Nevertheless, US relative failure to deploy does not detract from the success of network industrial policy in stimulating PV R & D. [7]

Wind energy systems

As NASA's future looked uncertain at the end of the Apollo space missions in the 1970s, it sought to build on its engineering successes and find new sources of federal revenues by pioneering R&D in wind energy, which the oil price surge of the 1970s made into a promising new energy source. On the demand side, the US Congress passed the National Energy Act, putting energy companies under obligation to offer attractive prices to wind energy suppliers to the grid. The government of California was especially active in promoting investment, to the point where by 1984 California was home to 75 percent of the world's commercial wind-energy capacity (Keller and Negoita, 2013).

[7] The collapse of Solyndra, the California-based manufacturer of solar panels, in September 2011, prompted the standard sing-along refrain from the right that "government cannot pick winners". The Department of Energy had given it a $535 million federally guaranteed loan to help move an innovation to full-scale commercial development. However, the loan came on top of large amounts of private investment, and it was private investors who were "picking winners". The company collapsed because its internal management was a mess (Nocera, 2011).

But most of the turbines in the US were imported from Denmark. The NASA/ Department of Energy wind turbine project largely failed to produce commercially viable ones. Why? Its mission-oriented approach led project managers to plan to "leap-frog" the commercial designs then available, starting at the beginning of the R&D pipeline, giving little attention to costs and production. They integrated few private manufacturers or users of turbines into their research programs. Moreover, their main manufacturers were the defence and aerospace contractors with which they had long-established relations, including Boeing, Lockheed, Westinghouse, Alcoa, and General Electric -- for whom wind turbines were a tiny side-line and for whom inter-firm collaboration was unwelcome.

In Denmark, private wind enthusiasts had begun to generate wider interest in upgrading existing technology by the early 1970s; and by the late 1970s had created several collaborative national associations. The state came in behind them ("following the market") with investment subsidies and a minimum purchase price for wind energy. Most important, it established a national wind turbine testing center. This center set standards and provided quality control, also gave advice and spurred collective problem solving between makers and users. Its engineers became the central pool of competences, acting as hub for the engineers and technicians at scattered (private) production sites. They had to approve investment projects before the investors got access to state subsidies.

Denmark's network success was the other side of the US failure to create a body to: (1) provide standards, certification and quality control in a new field, (2) bring users and makers together to share problems and solutions, (3) build trust, (4) sustain the government's commitment to promoting the industry.

<u>Advanced batteries</u>

By 2008 the US had only two domestic advanced battery manufacturers, and Japanese companies alone had 57 percent of the world market (Keller and Negoita, 2013). Yet in the early 1990s the federal government had led a consortium of three big US auto makers charged with developing new generation electric vehicles and advanced batteries. Ten years later it was generally considered a failure. One of the main reasons was its dominance by major auto companies. These companies marginalized small and medium companies in the venture, lobbied government against efforts to cut reliance on the internal combustion engine, and resisted links with battery companies.

Another effort began in the early 2000s with a new group of collaborators, which had little more success. This time one of the main reasons was the general lack of enthusiasm of the George W. Bush administration for promoting alternative fuels, and the resulting lack of enthusiasm of the intended collaborators. Also, many of the collaborators had outsourced production overseas, isolating relevant competences from each other.

The Japanese government started at about the same time as the US, the early 1990s, to develop advanced batteries. Ironically, it – specifically MITI – drew on lessons it had learned from US success at network industrial policy in forming collaborations between public agencies, universities and firms (a contrast with Japan's long tradition of centralized industrial policy). So it created a consortium including car makers, battery companies, government labs and universities, with a dedicated 10 year budget (much longer than the US equivalent) and a mandate to work simultaneously on basic and prototype research. It extended tax concessions to R&D undertaken specifically in university-industry projects; it encouraged commercial spin-off companies from university research; and it encouraged university professors to become company directors. The project was supervised by a unit within MITI, one of whose main aims was to ensure that

mutual benefit prevailed over opportunism (some companies utilizing others' knowledge without contributing their own). The participants had much more of their operations located within Japan than did their US counterparts, making it easier to forge links between complementary competences.

VI. Evaluation of network-building industrial policy

The foregoing is a small measure of evidence that the US has practiced industrial policy on a substantial scale, without much central coordination. In the words of Andrew Schrank and Josh Whitford:

"The federal government has been pursuing industrial policy within decentralized political institutions for well over a generation… American industrial policies go beyond preservation of market competition, maintenance of macro stability, and provision of public goods *to address firm-specific needs* in a host of different ways and through a variety of different agencies" (Schrank and Whitford, 2009).

In the words of another study,

"Below the ideological surface, a powerful 'jerry-built' substrate has emerged of federal, state and local government innovation support programs each filling gaps in the other" (Etzkowitz, et al. 2008, 685).

An official involved in these programs said, "We definitely see the programs as a de facto industrial policy, but *we cannot use that term*, so we usually call it R&D policy" (quoted in Schrank and Whitford, 2009).

How to evaluate these programs? One step is to challenge the presumption of the "varieties of capitalism" literature that the US's strong separation of powers (between executive, legislature

and judiciary, and between federal, state and local) handicaps industrial policy to the point where it tends not to be effective (see the Mann quote above).

The argument can plausibly be turned on its head. The decentralized type of US industrial policy has economic *advantages*: it better fits *both* the US's increasingly decentralized and networked production structure and its separation of powers. As previously vertically integrated firms have become de-integrated smaller firms have mushroomed, scattered around the country. By 2003 half of all PhD's employed by the private sector worked for firms with fewer than 500 employees, plus tens of thousands of PhD scientists and engineers who are self-employed or own a small business (Block 2011, 18). As their share of production grows, so their gains from networks with on-going relationships grow. By being brought into innovation networks they are more likely to compete on the high road (high skills, innovation) than on the low road (low wages). Moreover, decentralization – with programs run by many agencies at different levels and locations – encourages more experimentation.

A second step is to ask the question, if inter-firm networks can bring gains (not everywhere, but in sectors where demand is uncertain or volatile, supply interdependencies high, and technical change fast), why presume that the helping hand of the state brings net gains, on top of what would be achieved by networks formed autonomously by firms themselves? The short answer is that state involvement can help to correct "network failure" (in contexts where network governance would be desirable were it to obtain). Autonomous networks may fail (meaning absence of networks or fragile and short-lived ones) for at least two reasons.

One relates to the financing of innovation. In the general case production can be financed: (1) out of sales, (2) from bank loans or other borrowings, or (3) from equity issues. Investment in innovation may be financed out of sales by big established

firms but not by small new firms ; it can be financed only with difficulty from borrowings (debt) on the basis of prospective profits, because uncertainty is high; which leaves external equity as a major source of financing for innovation investment, especially for small new firms. But just because they are small and new these firms often have difficulty raising equity finance. Hence at the margin, financing from public agencies (whether in the form of debt or equity), and public validation of the worth of the investment, can tip the balance for private financiers and accelerate the R&D process (Shapiro and Milberg, 2012).

The second merit of state stewardship comes from the fact that networks – where (often competing) firms pool knowledge and perhaps specializations, in a spirit of reciprocity – are vulnerable to Prisoners Dilemma incentives. Firms may try to gain from others without reciprocating, prompting other firms to exit saying, "they screwed me". The authoritative hand of the state can curb the incentives to defect. Likewise the state can intervene in cases where firms want to exit because they think others are incompetent and not able to act reciprocally even though they want to; here exiting firms may say, "they screwed up" (Schrank and Whitford, 2009).

It is, however, difficult to evaluate the economic rate of return of scattered programs of the US kind, and these difficulties provide market fundamentalists with reasons to presume that they are a waste of taxpayers' money compared to whatever the free market would have delivered. But we can be confident that :

- The programs have developed valuable products and processes. Recently US government network-building has helped US firms to secure the lead in globally important industries ranging from mobile telecommunications, as seen in Apple's triumph over RIM and Nokia, to hydraulic fracking, whose economic potential was transformed by public-private research projects backed by the Department of Energy.

- The programs have been able to withdraw benefits from "losers", at least in the civilian industrial sector (as distinct from agriculture and defence, where post-2008 increases in agricultural subsidies and the defence budget force even more draconian cuts in non-defence public spending).

- Firm networks not encompassed in public network programs have a higher rate of decline or breakup – which on the face of it argues for the value of public involvement. For example, Sherrie Human and Keith Provan report that of the small firm networks (outside public programs) they studied in the mid 1990s more than 60% had broken up by the time of their restudy in 1998 (Human and Provan, 2000). Maryann Feldman and Maryellen Kelley provide evidence that firms within *publicly sponsored networks* are more likely to sustain collaboration than those outside (Feldman and Kelley, 2001).

In short, judging the success of particular network industrial policy projects or the whole program – comparing gains against costs, but in a dynamic rather than the standard static cost/benefit framework (where the "crowding out" costs tend to dominate the benefits) -- is inevitably difficult and open to dispute. But three points are clear. First, many network-building projects have produced large gains. Second, the presumption that the "free market" of competing private sector investors would have produced better results overall rests on ignorance of the gains obtained through inter-firm networks.

Third, the case studies of US successes and failures suggest that performance depends heavily on the specifics of policy and institutional "regimes" for each case, and is not determined largely by the mega-structures of varieties of capitalism, whether American, Japanese, Danish, or other. It is not obvious that agencies of the US state could not have produced successes

in some of the energy fields where they failed, described earlier, had they come closer to copying features of the policy regime in the same fields in other countries. It is not obvious, for example, that agencies could not have created testing and quality control centers for wind turbines like the one created by the Danish government without having the centers hamstrung by market fundamentalists. On the other hand, it is also true that the wind turbine industry in the US faced much greater opposition than in Denmark from the fossil fuel lobby.

VII. *Conclusion*

By way of conclusion, ten points. One, the US has developed a hidden "developmental state" over the past two to three decades, going well beyond the earlier focus on the military . Reviewing the history of US industrial policy since 1989 Fred Block remarks,

"What is most striking about this recent period is that, with the exception of the fights over ATP [Advanced Technology Program], there is a discrepancy between the growing importance of these federal initiatives and the absence of public debate or discussion about them….journalists rarely report on these programs, few academics write about them, and most politicians ignore them" (Block, 2011, 13).

Two, the existence of this array of industrial policy programs is surprising in the context of (1) the presumptions of mainstream, exchange-oriented economists that "industrial policy" is generally to be avoided, and (2) the presumptions of political economists and other institutionalists that the US political structure (three coequal pillars at federal level, and a federal-state-local hierarchy), plus market fundamentalist ideology, renders government-led attempts to steer investment ineffective, or worse. Also contributing to scholars' neglect is a presumption that industrial policy means East Asian/ French/

Brazilian-type policies complete with national indicative plans and high profile national steering agencies.

Three, when agencies have to justify programs of this type they invoke the familiar criterion of "government intervention to correct exceptional cases of market failure". This makes them seem consistent with standard neoclassical theory. But some of the programs go well beyond any plausible notion of correcting market failure, to the state imparting directional thrust towards new technologies where private profit-seeking would not draw investment on its own or where the agency sees a chance to accelerate the direction some private actors are already moving in.

Four, the recent empirical research provides a basis for theories of network success and failure, to put alongside the familiar neoclassical theories of market success and failure. The earlier discussion suggests several building blocks of such theories. For example, contrary to the thrust of the varieties of capitalism literature, the decentralized and network-building form of US policies may have net *economic* advantages (as well as the political ones): advantages from being a better fit with the emerging more decentralized form of production structure, in which a growing proportion of total output comes from smaller, less vertically-integrated firms; and advantages of experimentation and avoidance of "group think".

Another building block is the distinction between two causes of network failure: collective action breaks apart when some parties see others as "incompetent" ("I will exit because they screwed up") or when some parties see others as "opportunistic" ("I will exit because they screwed me"). Policies and institutions to promote networks have to counter both sources of failure (Schrank and Whitford, 2009). A third building block is the distinction between government leading the market, government following the market, and government promoting

more sector-neutral functions. In one sector or industry the government's role may alternate over time (Wade, 1990).

Five, for all the positive trends in both industrial policy practice and in social science understanding of it we have to remember that US high tech manufacturing is not in robust health. The trade balance in high tech products went from strong surpluses in the 1990s to a deficit of $100 bn in 2011. The supply of graduates in science and engineering is far from sufficient. IBM, Du Pont and others have been offshoring their R&D. Productivity growth has persistently declined over the past dozen years. One sign of the times is that China (as of 2016) has the largest number of computers among the world's fastest 500 supercomputers; it has the world's fastest supercomputer for the seventh year running; and its fastest machine uses Chinese-made microprocessors rather than from Silicon Valley's Intel (*International New York Times*, 2016).

Six, these trends are not ringing alarm fells as loudly as they should, reflecting (as one reason) a common assumption that as long as "start-ups" and "knowledge work" stay at home, we in developed countries should let the "scale ups" and their factory jobs go overseas to cheaper labour sites, and push for more trade liberalization (exchange) to facilitate this division of labour. This view expresses a misplaced faith in the power of start-ups to create jobs at home. Only "scale-ups", when technology goes from prototype to mass production, are an engine of job growth. *Scale-ups depend on pre-existing ecosystems of supplier-customer relations where technical knowledge accumulates and experience builds on experience.* Abandoning today's "commodity" manufacturing can preclude entry to tomorrow's new industry (Grove, 2010, Berger, 2013). So industrial policy should focus not just on innovation but also on incentivizing certain fields of commodity manufacturing at home, by making it less attractive for manufacturers to decouple from the national economy.

Seven, US industrial policy could be rendered more effective with more coordination between the various federal agency programs, by means of a central agency near the top of government with real muscle. Michael Porter, who used to deny the merit of national-level strategy, has come around to the view that

"Congress would benefit from a bipartisan joint planning group to coordinate an overall set of [development] priorities. More up or down votes on comprehensive legislative programs are needed to allow a shift to a coherent set of policies and away from lots of separate bills" (Porter, 2008).

Such a central agency exercising comprehensive foresight is crucial for formulating a path away from catastrophic climate change, given the needed radical changes in production and consumption (to raise the productivity of resources and cut the material content of consumption); not just in the US and the West, but for full global development.

Eight, one of the big flaws in US industrial policies-in-general is that state investment in R&D is not set in a venture capital framework, where the state gets financial returns directly from successful investments in the private sector made on the back of that R&D (as in the Apple example given earlier). The state absorbs high risks and uncertainties, and often bears high capital costs; some 57% of funding for basic R&D came from the federal government in 2008, only 18% from the business sector. But the state passes on the knowledge with no mechanism to receive a return on derived private innovations. The key is to establish revolving funds so that the inevitable losses on public R&D can be offset by the gains, as with private venture capitalists. This would make the funding of public R&D less dependent on a political process.

In the words of Mariana Mazzucato:

"Why is the State eagerly blamed for failed investments in ventures like the American Supersonic Transport (SST) project (when it 'picks losers'), and not praised for successful early stage investments in companies like Apple (when it 'picks winners')? And why is the State not rewarded for its direct investments in basic and applied research that lead to successful technologies that underpin revolutionary commercial products …?" Mazzucato, 2013, 88).

Nine, the various programs of the kind described here are to be understood as "inner wheels" of the American system of manufacturing, whose impacts depend heavily on outer wheels. One outer wheel is the amount of R&D to GDP. Here the US is far ahead of most countries: public and private investment in innovation was 2.8% of GDP in 2008, below Japan but much above the European Union-15 at 1.9%. But the US has become dangerously dependent on public-sector investment in basic research, as big publicly-quoted US firms become focused on financial engineering more than real engineering. A second outer wheel is macroeconomic management, which may be more, or less, friendly to different sectors: for example, high interest rates discourage capital-intensive investment, and overvalued exchange rates hinder export-oriented manufacturing. A third outer wheel is income distribution. The decoupling of productivity growth from incomes over the 2000s (the first time on record that the incomes of the *large majority* of Americans have stagnated or fallen through apparently good times to 2007) blunts the efficacy of industrial policy. Slow growth of median incomes relative to productivity is a recipe for anxiety, anger, an upsurge of "government is the problem, not the solution", financial crises, and lost decades (Wade, 2012, 2013).

Finally, the organized hypocrisy captured in the study of the US biotech industry quoted at the beginning – "government and business leaders simultaneously advocated government intervention to foster the development of the biotech industry

and argued hypocritically that government should let the free market work" – characterizes American industrial policy as a whole. See the epigraphs. With American industrial policy mostly tucked away from public and academic attention, the US government has not had to navigate the tensions inherent in telling other countries – directly in bilateral and regional trade and investment agreements and indirectly through Structural Adjustment Programs in the inter-state organizations where it is the dominant actor -- "do as I say, not as I do". It says simply, "do as I (say I) do". And so, ever since the 1980s, American and other western governments have applied strong pressure on developing countries to "follow comparative advantage" and keep specializing in exportable primary commodities, tourism and cheap-labor assembly manufacturing -- and stop pressing for "policy space" to develop production capabilities (Wade, 2013). This pressure continues imperial countries' long history of trying to stop peripheral countries from entering dynamic sectors. The post 1980s push relies not on gunboats, colonial restrictions, and racial ideology, but on conditional lending, "free trade" agreements, and neoclassical theory – the latter apparently justifying the proposition that developing countries should stick to their sectors of comparative advantage *in their own best interest*. This is a prescription for sustaining the existing core-periphery structure of the world economy, in which the activities with increasing returns, high linkages, and high price and income elasticity of demand are located mainly in the core, sustaining the core's prosperity relative to the periphery (Wade, 2003). One lesson from this essay is that policy communities in other countries and in inter-state development organizations like the World Bank and IMF should push back when American policy makers and academics urge them to stick to the Washington Consensus "fundamentals" whose efficacy can be seen from the economic success of the United States. The key point is this. For a developing country to sustain movement of the production structure into higher value-added activities (deploying technologies mostly developed elsewhere) the Washington Consensus agenda — opening the

economy to the international economy and improving institutions of *exchange* — is at most a necessary condition. The American experience, and that of just about all the post-Second World War success stories, underlines the need for public policies to incentivize the *production* of some activities over others. Creating a level playing field does not ensure that the players turn up to play. END

19 July 2016

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