

# **Searching for China's Technological Champions: What Past Structural Flaws and Policy Failures Tell Us about the Likelihood of Success for Current Policies**

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## Searching for China's Technological Champions: What Past Structural Flaws and Policy Failures Tell Us about the Likelihood of Success for Current Policies

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Now that we are forty years into China's economic reforms, it is fair to compare China to the previous two (and only two) economies to grow from poverty to wealth in the post-World War II era, South Korea (hereafter referred to as Korea) and Taiwan. When one does so, what is striking is the dearth of technology champions in China. Forty years into Korea's takeoff (2002), Korea already boasted Samsung Electronics, LG and the various firms affiliated with the Hyundai chaebol. True, Korea was already much wealthier than China is today on a per capita basis, but it was a much smaller economy. Similarly, Taiwan in 1995 (and arguably Taiwan's real takeoff did not take flight until 1958 rather than 1955) was a high-income economy, and despite its small size could boast to be leading the way in the innovation of a new business model pioneered by TSMC in the technology-intensive semiconductor industry. In China, the only truly technologically impressive, globally competitive, consistently profitable and large-scale domestic company is Huawei. In other words, in spite of decades of China's industrial policy, the second largest economy in the world does not have much to show for its efforts.

This report attempts to explain the limited emergence of Chinese technology titans. The first section examines the structural reasons there has not been great success in pro-active (as opposed to passive, tariff-driven infant industry protection) industrial policy in building technology-intensive firms in China. The second section turns to look at how sectoral characteristics shape the opportunities for technological upgrading among Chinese firms given the state's policies outlined in the first section. The third section addresses the important issue of market regulation and how that has impacted upgrading in various industries. The fourth section examines the critical role that foreign venture capital has played in China's technology sector, and the implications of the current surge of domestic venture capital. The final section will address continuities and departures with China's past industrial development in Xi's industrial policies.

### The Sorrows of Industrial Policy

In the case of China, there are four serious constraints to the effective pursuit of industrial policy: (1) the structure of the state apparatus, (2) the bias of credit allocation toward SOEs/state-favored firms and the resulting managerial deficiencies of these firms (3) the information asymmetries due to sheer geographic size and population of China and (4) the balance of exports vis-à-vis procurement. These obstacles are in addition to the incentives for local officials that prioritize investment and land grabs over implementing upgrading of local firms

and multinationals within their jurisdictions discussed by Fuller (2016, Chapter 2).

There is a large, time-tested stream of scholarship about the fragmented nature of China's state with ferocious battles between horizontal (regional) and vertical lines of authority (the problem is referred to as *tiao tiao kuai kuai* (条条块块) in Chinese with *tiao* referring to the vertical lines of authority and *kuai* referring to the horizontal/regional authorities) (Schurmann 1968). Priority-setting at the central government level is weak and the *tiao tiao kuai kuai* jurisdictional conflicts further exacerbate this weakness (Lieberthal and Lampton 1992). Local officials enjoy a "soft authority constraint" to interpret government directives as they wish (Lu and Tang 1997).

The second and arguably most important issue is the financial misallocation and lending bias towards SOEs (Chen 2015; Huang 2003, 2008; McMahon 2018; Pettis 2013) and other state-favored if not explicitly state-owned firms (Fuller 2016). Some would go so far as to argue that there is state paternalism on behalf of client SOEs (Moore 2002). While Naughton (2010) argues that the State Asset Supervision and Administration Commission (SASAC) now rewards the central SOEs under its supervision with managerial incentives, others questioned whether this is effective given the larger political aims of the top management teams after their tenure in a given SOE (McGregor 2012) and the power of SASAC over central SOEs given that the power of appointment resides with the Organization Department of the CCP (Walter and Howie 2011). The promises of thoroughgoing financial reform made during the Third Plenum of the 18th Party Congress have by and large not been kept with the exception of the partial liberalization of interest rates.

Given China's large population and geographic size, the information asymmetries facing industrial policymakers in Beijing are much larger than in the Northeast Asian states that conducted relatively successful industrial policy (Perkins 2001). Nor is it just the sheer size of China that makes the requisite policymaking and coordination difficult. Multinationals have a much larger presence in the Chinese marketplace than they did in the developmental heydays of Korea, Taiwan and Japan, and this presence makes state coordination of firms more difficult (Naughton 2010).

Fourth, China simply is not as export-dependent as Japan, Korea and Taiwan were in their developmental heydays, and this presents a major challenge in judging firm performance. Haggard (2004) has argued that these states did not actually have to be very effective at monitoring their firms because they could use the external and hard-to-manipulate metric of exports to judge firm performance. As a continental-sized economy, it is quite natural for China to be less export-dependent, but this fact also means that the Chinese state faces higher informational asymmetries that make judging firm performance more difficult. The domination of China's export sector by foreign firms that are not the main targets of China's industrial policy exacerbates the information asymmetries working against China's state bureaucrats. On top of these problems, the state's own procurement policies provide incentives for the state-favored firms to focus on the domestic, and especially state-governed, markets that only add to these information problems.

One area where there has been some tentative success in creating domestic champions are the new energy sectors. China has poured funding into creating a market for these new energy products and via protection encouraged technology transfer from established firms (Lewis 2013). Given the relatively new, immature nature of these products, China's ability to leverage its large resources to create markets for these products via procurement has been impressive. However, only a handful of truly innovative or entrepreneurial firms have been able to reduce their reliance on China's state procurement and start to compete successfully abroad (Studwell 2018). The most impressive is Goldwin, which has a state-owned pedigree, but like state-favored Huawei,

Goldwin has bucked the incentives to remain reliant on state procurement.<sup>1</sup> Goldwin is now one of the “Big Four” global wind turbine manufacturers.

## Sectoral Characteristics and Success

There has been variation in technological catch-up across sectors in China’s economy. For more medium-tech technology, machinery-based sectors, China has experienced a fair amount of upgrading among domestic firms (Brandt and Thun 2010, 2016). For many high-technology sectors, China’s record of catch-up among domestic firms has been weak, and hybrid firms located in China but financed from outside of China have driven technologically upgrading. And it must be noted that for even the mature, medium-technology industries, Brandt and Thun (2010, 2016) find little evidence for effective industrial policy beyond the tariff barriers that encourage multinational corporations (MNCs) in these industries to set up factories in China.

There would be no problem with such a hybrid model of high technology development except for two issues. First, industrial policy has wasted a tremendous amount of resources on the domestic firms in high-technology areas. Second, the hybrid model itself is under threat as will be discussed later in this report.

Hybrid firms have thrived in particular set of industries that are often dubbed “high-tech.” The hybrid works best in those industries characterized by the following features: feasible modularity of the value chain, fast clockspeeds, and relatively high technological intensity.<sup>2</sup> The combination of feasible modularity and high clockspeeds generally leads to modularity of the value chain and thus lowers the barriers to entry for smaller firms bereft of internal or external scale and scope economies. Higher technology intensity leads to more segments along the value chain generating relatively high value so there are opportunities along the chain for firms to capture significant value. This section will explore each of these features in turn (so those of you who are not interested in global value chains and modularization can skip the next five pages).

Many scholars have documented the radical changes in the organization of industrial value chains over the last several decades (Arndt and Kierzkowski 2001; Berger 2005; Gereffi et al. 2005; Langlois 2003; Sturgeon 2002; Thun 2007). In particular, these scholars have noted that many value chains have become modularized. The basic idea of modularization<sup>3</sup> of the value chain is that value chains can be broken down into parts (modules) with clearly defined (a) functions and (b) interfaces between the different functions. These clearly defined interfaces allow for relatively frictionless/low-cost transfer of information from one function (module) to the next. These interfaces ease the flow of information, lowering the transaction and coordination costs between modules. They thus allow firms to concentrate on just a few modules of the value chain without requiring co-location with other firms up- and downstream along the value chain. Thus, the modularization/fragmentation of the value chain allows for firms to de-verticalize while freeing them to disperse geographically (Arndt and Kierzkowski 2001; Berger 2005; Thun 2007).

For industries where such fragmentation has taken place, the implications for states and firms in the developing world have been profound. Past successful developers concentrated on building capabilities within

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<sup>1</sup> See Fuller 2016 (Ch. 3) on how Huawei defied the state-provided disincentives to innovate. A complementary analysis to Huawei’s strategic interactions with its external institutional environment is the masterful new study of Huawei’s internal management changes over time (Murrmann *et al.* 2017).

<sup>2</sup> This section draws on Fuller (2013).

<sup>3</sup> Also referred to as vertical specialization or disaggregation/fragmentation of the value chain.

industrial behemoths featuring substantial vertical and horizontal integration, such as the Japanese keiretsu and Korean chaebol, or fostering clusters of same-sector firms, such as Taiwan's IT cluster in Hsinchu. Industrial policy focused on building up the necessary internal and external scale and scope economies in these behemoths and clusters. Prospects for smaller individual firms outside of clusters anywhere, but especially in the developing world, appeared bleak prior to the fragmentation of these value chains (Arndt and Kierzkowski 2001). In developing countries without effective industrial policies to help build the internal or external scale and scope economies, such firms faced nearly insurmountable obstacle to compete. With the fragmentation of value chains, small firms in the developing world could engage suppliers and customers globally while concentrating on a narrow band of activity in order to lower the cost of entry into an industry.<sup>4</sup> As discussed later, fast technical change goes hand-in-hand with modularized value chains in terms of the type of industries that offer the best prospects for new entry by developing world firms. Thus, disaggregation of the value chain can help lower barriers to entry in precisely those industries where state industrial policy is likely to be less effective.

How does modularity vary across industries in terms of providing wider opportunities for industry entry into the higher value-added segments of a given industrial value chain? The critical factor is a combination of the feasibility of modularity and the technical clockspeed (Fine 1998, 2000) of the industry. Feasibility of modularity is the basic capability to modularize the value chain through developing interfaces where information can be codified and transferred across the segments. The industrial clockspeed is the pace of technical change controlling for product complexity (Fine 1998).<sup>5</sup> As Steil and his colleagues (2002) and Fine (1998) among others have pointed out, industries with faster paces of technological change are more likely to be de-verticalized both due to lower, even negative, returns to scale (Utterback and Suárez 1993; Christensen et al. 1998), and fewer opportunities to add much value by operating across segments in the value chain. A number of authors have noted the propensity of slow clockspeed industries to be more vertically-integrated, but fast clockspeed industries are not necessarily modularized either if there are not ways to enhance the standardization and digitization of the production chain as the pre-digital era IT industry demonstrates (Fuller et al. 2013; Thun 2007). Christensen (1997) also argues forcefully for the necessity of vertical integration of non-standardized segments of the value chain.

The greatest opportunities for those developing world firms bereft of the support of effective state industrial policy are in sectors where feasible modularization and clockspeed are both high. If one or the other is not high, the scale and scope barriers present difficulties for these firms. Indeed, these barriers to entry are the main justification for protecting and promoting infant industries until they grow large enough to compete. What the combination of high feasible modularity and high clockspeed creates is a highly modularized production chain that allows small firms without the internal or external (cluster-provided) economies of scope and scale to enter the industry more easily.

What further differentiates these industries is the value they generate. Therefore, the most promising industries in developmental terms are those industries where modularization is high, technical change is fast, and technology-intensity (and correspondingly, the economic value created) is high. The garment industry is an at

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<sup>4</sup> Firms could invest smaller sums towards the production and technical skills required within a given module rather than having to invest on a much larger scale to build capabilities across a wider set of activities along the value chain. Furthermore, in those sectors with a fast pace of technical change, state industrial targeting is probably less effective as state fast pace of technical change, state industrial targeting is probably less effective as state policy has difficulty keeping pace with changing requirements within the industry (Schmitz 2007).

<sup>5</sup> Fine focuses on several types of clockspeed in his work with the principal ones being process and product technology clock speeds. It is important to note that clockspeed is *not* a measure of the technological intensity of the industry as some industries with slow clockspeeds, such as commercial aircraft with its product technology generations of ten to twenty years, are technologically intensive (Fine 1998).

least moderately high clockspeed sector (product generations are relatively short although process technology changes slowly), but the economic value generated in this low-technology sector is relatively small and mainly captured by firms from the advanced world in the modules of design and distribution (Arnold 2010; Gereffi 1996). Many developing world firms have easily entered this sector without much state support, but most of them have simply relied on labor arbitrage. Historically, successful developers have had to move into other more technology-intensive sectors in order to become wealthy.

Sectors such as IT and biotechnology are modularized with high clockspeed and high technology-intensity (Rezaie 2012)<sup>6</sup> so they offer the most promising routes for development for small firms without state backing—like the hybrids—to build scale and scope economies. While the sectoral constraints for the hybrid model are somewhat restrictive, some argue that more and more value chains are becoming fragmented, which suggests more value chains meet at least the first two of three criteria (Langlois 2003). Thus, the potential sectoral scope of the hybrid development path is probably widening over time.

In contrast, in the medium-technology, machinery-based industries characterized by medium product clockspeeds and relational (as opposed to modular) value chain governance (relational value chain governance features iterative, in-depth information exchanges and cooperation between firms on adjoining segments of the value chain), Chinese domestic firms were able to benefit from the movement of the supply chain to China. Chinese final assemblers were able to leverage their interactions with key, multinational suppliers to improve their own products and close the gap with their MNC competitors, which were relying on many of the same MNC suppliers (Brandt and Thun 2010). Furthermore, these sectors did not attract the type of foreign venture capital (VC) that comprised much of the funding for hybrid enterprises in China so such firms basically do not exist in these sectors.

Could sectoral characteristics point to technology-intensive industries where China's proclivity for enormous investments over extended periods of time would work (i.e. this support would not prove to be a double-edge sword that lowers investment costs but also dulls the ability to react to swift market and technology changes necessary to compete in the high-tech sectors outlined above)? As James Fallows has argued, although not using these precise value chain terms, China's determination to throw money at the large passenger aircraft market may very well work. This sector has very long product cycles and relatively hierarchical value chain governance (e.g. witness Boeing's disastrous experimentation with more modular outsourcing) that fit well with China's desire and ability to spend copious amounts of money over decades to build in-house capabilities in designated national champions although this sector-policy proclivity fit by no means guarantees success.

## Regulation of Competition

Brandt and Thun (2016) in revisiting the machine sectors they analyzed over time have concluded that some sectors were much less successful than others even though they shared the benefit of MNC suppliers investing in China. They concluded that the state regulation of market competition to keep out rather than encourage competition was holding back those sectors that achieved less upgrading. The auto industry is a case in point. The state kept primarily private firms from entering into this market for decades, and consequently, the local state

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<sup>6</sup> Lee (2013, 84) claims that biotechnology has a medium cycle-time, but in fact his data shows biotech to be below average, i.e. above average in clockspeed.

champions, despite benefitting from being the partners of the joint-ventures (JVs) required for MNCs entry, failed to upgrade effectively. In contrast, construction equipment, where there was a veritable free-for-all of foreign, state-owned, private, and other firms in the gray corporate area between state-owned and truly private, witnessed impressive upgrading. To underline Brandt and Thun's point, the most promising domestic carmaker today is a late arriving (due to state barriers to entry), private firm, Geely.<sup>7</sup>

Encouragement of fierce market competition by encouraging or at least tolerating easy market entry worked for many other sectors for periods of time as well. The relative success of China's white goods makers, especially Haier, can in part be attributed to the fierce competition between many different small domestic entrants in the early days of the industry in China. Likewise, the fierce competition and low entry barriers in the telecommunication infrastructure equipment industry in the 1990s allowed for the emergence of competitive Huawei and ZTE, a private and local SOE on the periphery of the state's favor, respectively (Fan 2011; Harwit 2008). Unfortunately, in the telecommunications market in the last decade or more, the state has shown more concern for supporting the laggards, ZTE and Datang (Fuller 2016, Ch. 3), than for encouraging competition.

In the internet industry, China's protection of its market while tolerating competition among firms with many different organizational forms, including hybrid firms, has been quite successful in building up internet titans. Until recent years, many of these giants, such as Tencent and especially Alibaba, could be characterized principally as business model innovators as opposed to science-based technology innovators. However, even these firms have begun to pour resources in science-based "hard" innovation. Unfortunately, the state's heavy hand of regulation over information has caused some innovation casualties in this industry as well. For example, a decade ago, Google took competition from Baidu in internet search very seriously, but the heavy hand of state censorship-cum-interference has essentially undermined Baidu's search capabilities.

## Domesticating Venture Capital

Virtually every big name in technological or business model innovation in China that emerged out of the start-up scene over the last two decades received the majority of its funding from overseas venture capital (VC). From the triumvirate of Baidu, Alibaba and Tencent (BAT) to more recent success stories, such as Xiaomi, foreign venture capital has played a critical role in China's start-up scene. In short, VC was the main conduit for creating the hybrid firms driving China's technology development.

Why has foreign venture capital played such an outsized role? Prior to 2007, one could point to the fact that China did not have the legal framework for general-limited partnership structures commonly used for venture capital in the U.S., U.K. and elsewhere. However, even after this problem was resolved through revisions in China's Partnership Law, foreign venture capital has still played an outsized role in China's financing of technological entrepreneurship.

One way to understand why this has been the case is the bridging function foreign venture capital plays in linking Chinese entrepreneurs to institutions abroad better able to support technological entrepreneurship. Whereas the domestic stock markets remain unattractive due to its speculative nature (due largely to the dearth of

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<sup>7</sup> In 2017, the top six auto makers by sales value were in descending order the two VW JVs, the two GM JVs, Geely, and Ford's JV.

large institutional investors) and the state's slow and biased process of deciding which firms can list, foreign venture capital has deep experience in listing start-ups on stock markets abroad.

Additionally, the experienced venture capitalists capable of vetting start-ups have clustered in the foreign VCs until quite recently. Indeed, this lack of talent in domestic VCs, especially earlier on in the development of China's VC industry, helps to explain the few domestic success stories as well as the many failures in VC. World Bank data from 2009 shows that domestic firms including JVs contributed only 11 percent of the venture capital funds for start-ups with foreign firms providing the rest.

Another problem for domestic VC firms is that they tend to be state investment vehicles, and thus are often directed to investment in basic infrastructure, state projects and just about any other sort of investment besides providing capital to start-ups. Exacerbating these problems, local and regional funds understandably want to restrict investments to their own locales. The guidance funds set up by the central and local governments in 2007 only exacerbated this problem. According to *Venture Capital Development in China 2013*, the surge in funding drove down seed and early stage funding from roughly half the total (similar to the percentage spent on venture capital vis-à-vis private equity in the U.S.) in 2006-2009 to 40 percent in recent years. The actual venture funding is likely to have been much lower as this yearbook uses a much broader and arguably less accurate definition of venture capital than the World Bank study cited above.

Since 2014, there has been a new round of setting up government guidance funds. In 2016 alone various central and local authorities set up 442 guidance funds with the goal of raising 3.6 trillion RMB in funds according to the *Economic Observer*. These numbers need to be treated with a great deal of circumspection (there are reports from investment partners that many funds have trouble coming up with the money they claim they have). Zero2IPO's figures for 2016 are smaller and likely more accurate. Nevertheless, Zero2IPO reports a still whopping 1.37 trillion RMB raised by venture capital and private equity firms with the bulk of the funding coming from 323 government guidance funds. No matter which figures one believes, there is no doubt that the Chinese government intends to support venture capital lavishly.

On the more positive side, there are some signs of learning by the state in how to foster venture capital. Money going into venture capital today is more likely to be in terms of actual venture investments with equity taken in return for investments instead of the direct subsidies without equity stakes, which was more common in the past. Furthermore, VC talent has moved into domestic firms. Given that it has now been a quarter of a century since the first foreign VC set up shop in China when IDG arrived in 1992, it is unsurprising that experienced venture capitalists are no longer solely found in the foreign VCs operating in China. Some experienced venture capitalists have even become the managers of government guidance funds.<sup>8</sup>

And yet for all the money thrown at venture capital and the progress made operationally, many problems persist. Many of government guidance funds still invest on many other things, such as infrastructure, rather than supporting early stage entrepreneurship. These funds often still have very restrictive rules about where they can invest and in what industries. Even while reaching out to experienced venture capitalist organizations, including foreign ones, to help them manage their guidance funds, there are reports of guidance fund managers demanding kickbacks in the form of salaries and other benefits from the VCs they aim to hire to invest on their behalf. Finally, the surge of state funds plus loose monetary conditions has created a new problem that bears a strong

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<sup>8</sup> This section draws on Douglas B. Fuller 2017, "The Critical and Contested Foreign Links for China's High-Tech Entrepreneurship," *China Policy Institute: Analysis*, May 9.

resemblance to Silicon Valley: too much money chasing too few good investments. In fact, China has more of a bubble brewing than Silicon Valley as China's investments keep rising year-on-year in 2016 while Silicon Valley actually retrenched in 2016 compared to the previous year.

With persistent problems among the domestic VCs and the prominent role foreign VCs have played in backing China's great venture-backed start-up successes over the last two decades, one would think foreign VCs' place in China's tech entrepreneurship ecosystem would be secure. Unfortunately, these successes are in tension with many of the techno-nationalist ambitions and even bureaucratic ring-fencing activities emanating from the central government. Fortunately, informal alliances of tech entrepreneurs, foreign venture capitalist and local governments, which want venture investment from wherever, have also provided so discreet pushback to give foreign VCs the space to operate within China's entrepreneurial ecosystem.

Conflicts over State Administration of Foreign Exchange (SAFE) proposed regulations in 2005 that threatened to kill inadvertently the ability for foreign VCs to invest in China. Behind the scenes, local entrepreneurs, local governments with clusters of foreign VC activities such as Shanghai, and foreign VCs successfully lobbied SAFE to reverse these regulations the very same year. Similar, China Securities Regulatory Commission and Ministry of Finance in 2012 and 2013 squabbled with the Security Exchange Commission of the U.S. over access to auditing records, but a compromise was reached because the alternative was to face a sharp decline in foreign VC investment in China given the dramatically narrowing of exit options if listing in the U.S. were to become impossible.

Past compromises and even outright victories reaffirming the regulatory space for foreign VCs to operate in China do not necessarily guarantee a smooth future. Despite their continued problems, the rising number of local funds may mean local allies are harder to come by for foreign VCs at a time when the trends of the past five years indicate a hardening line against foreign investors more broadly. All is not bleak however. Chinese investors want more and more access to early stage investment opportunities abroad and they may become natural and powerful allies for keeping venture capital flows open in both directions.

One must emphasize that any diminishing role for foreign VCs is not an unmitigated disaster for technological entrepreneurship in China. The increasing quality of some local funds and the rise of BAT as major venture investors mean that the critical role played by foreign VCs will naturally diminish somewhat.

Unfortunately, like so many reforms in China in the last two decades, for every step forward, there is at least half a step back. China's regulation of IPO is not a move to a true, light-touch registration system. Instead, the government has imposed a rigid formula for IPO listings that has pushed VCs to insist on puttable forms of equity investment. These puttable forms of equity investment are not suitable for technology start-ups that need financing for technological development as opposed to start-ups focused on business model entrepreneurship. To understand why, one must consider the nature of venture capital investments and why they are suitable for high-risk, technological development-focused ventures. As Deeg and Hardie (2016) have noted, VC is a long-term initial investment (VCs are rewarded upon exit which usually takes a long time) emphasizing growth with little focus on efficiency-maximization and financial engineering. Such quasi-patient capital investments are very well suited to high risk, technological entrepreneurship (Lerner 2008). Making the equity investment puttable undermines the long-term nature of the investment commitment and converts such investments into relatively short-term ones, or at least potentially short-term ones. Such short-term investments are not suitable for sustaining the technological investments yielding no profits in the short-term that technology start-ups need to make.

## Continuities and Departures in Industrial Policy under Xi

Much concern and even fear has been generated in Europe, Japan and the U.S. over 2015's Made in China (MiC) 2025 program, and the subsequent 2017 Next Generation Artificial Intelligence Development Plan. Beyond these plans, there are some broader environment changes of which we must be cognizant. One notable difference with the recent past has been China's tremendous explosion of domestic venture capital funding just discussed. While a bubble is building, this surge in venture funding may prove to be the turning point for creating sustainable, homegrown financing for technology entrepreneurship in China. However, the continued heavy state hand in listing procedures in China still allows overseas funding and eventual overseas listing to be attractive options even in light of the government's new promotion of CDRs to lure established firms to list at home.

Alongside this optimistic development, there is the very worrisome development of Xi's doubling down on Leninist controls in the corporate world. This phenomenon manifests itself on numerous fronts. There are increased pressures for foreign firms, especially JVs, to allow party committees to have a say in the running of their Chinese operations. The Chinese state is wrangling board seats from the most successful and foreign-listed technology firms. And MiC 2025 itself aids and abets these Leninist gambits.

The MiC 2025 builds upon previous announced policies of the past ten years, and not surprisingly exhibits some of the flaws of past industrial policymaking. First and foremost, too many state-owned firms are the vehicles of choice for pursuing these industrial policies. Second, and worse still, the funds provided for these industrial policies are often used to spur the state takeover of private (often nominally foreign) companies and assets. Third, state procurement appears once again to be one of the preferred means of supporting these industries. Given that such procurement is not typically distributed to the most capable firms, much of the spending on these various industries may prove to be both ineffective and wasteful.

Understandably, the scale of the proposed plans has alarmed foreign companies and countries alike. Even if China's flawed industrial policymaking process does not lead to success, it may still lead to adding large amounts of capacity in various sectors. In other words, there is the possibility that relatively ineffective industrial policy could create a lose-lose situation in which inefficient Chinese capacity crashes the global market in a certain good (e.g. DRAM) without actually spurring sustainable development in China. However, I expect going forward that these industrial policies will face both financial and human capital constraints that limit the effective added capacity in some of these sectors. Of course, these industrial policy limitations are unlikely to alleviate the American government's concerns about loss of intellectual property via forced transfer or theft as outlined in USTR's 2018 Section 301 report. ■

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