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Panel I: "The Chinese Communist Party's Economic Ambitions: Is the Past Prologue?"

A Statement by

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Introduction

In China, there has always been tension between political order and economic outcomes. A succession of highly centralized authoritarian states—imperial, republican and communist--have seen prosperity as a key source of legitimacy, however each has been equally aware of the need to protect a tightly interwoven set of political, economic and social ties that underpin centralized authoritarian rule. Bottom-up economic change is inherently disruptive of these ties.

Western technology has been viewed in a similar light. While a vehicle for building Chinese national strength, the introduction of new technologies can upset the flow of resources and rents aligning elite interests. New ideas, attitudes and institutional arrangements associated with Western technology and thinking can also threaten the foundation of China's polity. As prominent official Zhang Zhidong popularized in a famous epigram in the 19th century, "中学为体，西学为用"，China needed to **utilize** （用）western technology and devices while retaining its own cultural **essence**（体）.

Over the last decade and a half, China's leadership has articulated a comprehensive, top-down economic strategy that aims to reshape the country's economy and its economic interactions with the rest of the world.[1] At the core of this strategy is a priority on "indigenous" innovation and technological development to provide independent control over mature industries, as well as the newly emerging technologies and value chains that will define the 21st century. Leveraging its huge and growing domestic market, overseas foreign direct investment to secure access to critical raw materials and complementary technologies, and in concert with major initiatives such as One Belt, One Road (OBOR) for tapping new markets, Chinese leadership aims to promote a more "China-centric" system that increases "self-reliance", reduces external threats and risks, and enhances the prospects for sustained and more balanced growth. All three are viewed as critical to the long-run success of the CCP. Combined with even more

[1] The vision is reflected in the 15-year "Medium to Long Plan for the Development of Science and Technology (2006), the focus on "Strategic and Emerging Industry" in the 12th Five Year Plan (2010), "Made in China 2025" (2015), and most recently in the 14th Five-Year Plan.

recent efforts to extend China's influence over technology standard setting, global governance, etc., these policies entail both a decoupling *and* recoupling on new terms.

In key respects, this course represents a departure from main elements of a development path that evolved over the course of the first three decades of reform from 1978-2007. Through a combination of bottom-up, decentralizing domestic economic reform and external opening, China was able to achieve impressive average annual per capita economic growth of 8 percent, advance that helped pull hundreds of millions out of poverty. Integration with the rest of the world provided access to capital, technology, managerial knowhow, and markets, and was instrumental in forcing domestic economic restructuring. As Premier Zhu Rongji remarked at the time: "The competition arising [from WTO membership] will also promote a more rapid and more healthy development of China's national economy."

From the outset of economic reform, there have been competing visions of the role of the state versus the market in shaping China's economic future. We observe domestic market liberalization in the form of the "dual-track", openness to FDI, and falling barriers to new firm entry, but also more top-down interventionist polices and regulations working in the opposite direction that targeted critical industries, firms and technologies, and pushed self-sufficiency.

To make sense of China's more recent policy shift, it is helpful to take a step back and revisit the first three decades of reform. Over this period, tensions between alternative perspectives appear at both the micro and macro level. Without being too "deterministic", a much clearer thread runs through the post-1978 period than is usually acknowledged. The last 10-15 years, China has been successful in slowly reconfiguring how it is tied to the rest of world. Trade as a share of GDP has declined; more of exports now go to emerging markets; exports by domestic firms have increased significantly relative to foreign firms, and outward FDI is now on par with inward FDI. But by most measures, growth and dynamism in the Chinese has slowed considerably, well before diminishing economic potential would predict. This has important implications for China's ability achieve its ambitious objectives, but also for the rest of the world.

Context: The First Three Decades

Between 1978-2007, a combination of decentralizing economic reforms and openness provided powerful incentives for households, firms and cadres to leverage China's considerable human capital, entrepreneurship, and "latent" economic potential to generate impressive growth of 8 percent per annum. This potential existed in trade, industry and agriculture. On the eve of the Global Financial Crises, per capita GDP in China was on the order of 20 percent of that in the US. With a population nearly four times larger, its economy in absolute size was nearing that of the US.

China's economic success conceals important tensions that emerged early on between economic and political objectives, especially those tied to efforts to re-strengthen centralized authoritarian power and the state. The Cultural Revolution greatly weakened the central

bureaucracy and state, thereby enabling decentralizing, bottom-up economic reforms to go forward (Walder, 2016). The same reforms however left the state and the CCP without the critical resources needed to rebuild political patronage and networks, to implement ambitious economic plans centered on the state sector, and for supporting its non-economic objectives. Decentralization also offered new paths of upward mobility—economic, social and political--that potentially challenged the CCP.

Through the first 15 years of reform, the state and CCP struggled to find the resources to achieve their goals. Efforts to "enliven" the state sector through the "dual track", better managerial incentives, and technology transfer from the west through leading multinationals met with limited success. Much of the economic success was in the countryside in agriculture and the TVEs (township and village enterprises) complemented by a nascent external sector centered in the SEZs. Both the ratio of government fiscal revenue to GDP and the center's share of overall revenue, much of it coming from SOE profits, declined sharply. (Bird and Wong, 2008). The state's commitment to the state sector did not waver, however. Efforts to redistribute resources from the dynamic non-state sector to the lagging state sector through the financial system were the source of the boom-bust cycles China experienced (Brandt and Zhu, 2000). Urban protests in the spring of 1989, provoked by rising inflation and corruption, and the break-up of the Soviet Union were an important political call to arms.

In the mid-1990s, a major set of reforms helped resolve this fundamental contradiction. They also provided the basis for continued rapid growth up until the Global Financial Crises. These reforms included fiscal recentralization; the recapitalization of the banks and financial reform, including the reorganization of the Peoples' Bank of China (PBOC); restructuring and downsizing of the state sector, and entry into WTO. Tax reform implemented in 1994 reversed the long decline in the GDP share of fiscal revenue, increased the central government's claim on overall revenue, and perhaps more important for re-establishing central authority, ensured that provinces were dependent on central transfers to finance expenditures. The state also selectively retreated from the economy, exiting those sectors no longer deemed "strategic", shedding tens of thousands of firms, and tens of millions of urban workers in unproductive firms in the process. SOEs remained dominant however in "pillar" and "strategic" sectors such as aeronautics, chemicals, iron and steel, and electrical machinery, and in capital-intensive upstream sectors such as power, telecommunications, transportation, and finance (Pearson 2015).

The Role of Productivity-led Growth

Chinese growth is often mistakenly described as investment and export-led, however the most important source of growth during the first three decades was productivity gains, which were the source of in upwards of 70 percent of per capita GDP growth (Zhu, 2012). The remainder came from capital deepening and huge investments in human capital. This performance is in sharp contrast to the period between 1952-1978 during which productivity growth was negative.

Productivity gains at the aggregate level were a product of improvements within individual sectors, i.e., primary (agriculture), industry (mining, manufacturing, utilities and construction), and services, as well as from the reallocation of resources, e.g. labor and capital, from low to high productivity sectors and firms. Between 1978 and 2007, the share of the labor force in the primary sector (agriculture) fell from nearly 70% to 30%, as non-primary employment increased by more than 300 million workers. Relaxation on migration from the countryside to the cities, especially those in coastal provinces, played an important role in the transfer. China also benefitted from the reallocation of resources--labor and capital--between the state and non-state sectors.

Productivity growth in the aggregate conceals a mixture of dynamism and inefficiency permeating the Chinese economy. Much of this is tied to differences between the non-state (largely private) and state sectors and reflects deep-rooted tensions between economic advance and the state's non-economic objective. High returns to investments in the non-state more than offset the low and often negative returns in the state sector, allowing for economic advance. State investment increased in critical infrastructure such as transportation, ports, communications networks, and power, but huge rents were often embedded in these expenditures. State investment was often used to advance political objectives -- patronage and network building, regional development, e.g. China's western development program, national security, and demonstrations of national might. State-owned firms in strategic sectors (and state-connected individuals) were the major beneficiary of these policies. With capital formation by the state on the order of twenty percent or so of GDP, the flow of resources here was massive.

The mid-to late-1990s' reforms put China on a much more solid macro-economic footing and provided the state with the resources to meet their objectives without risking growth, at least in the near to medium term. Since the mid-1990s, the share of GDP tied directly to the state sector has remained remarkably constant at 45 percent, with non-financial SOEs consistently representing in the vicinity of 20 percent, and financial SOEs slightly more than 5 percent (Batson, 2020).[2] The state share of GDP through ownership in industry declined, but this was more than offset by the increase in the more rapidly growing tertiary sector. With the formation of the State Administrative of State Assets Commission (SASAC) in 2003, a succession of mergers consolidated central control within strategic industry and services in enterprise groups that would soon then enter the ranks of the Fortune 500.[3] At the same time, the state continued to dominate China's financial system, even as the share of China's four largest state-owned banks of total financial assets declined. The state's share of total capital formation also remained in the vicinity of a half, or nearly 20 percent of GDP.

[2] The remaining 20% is the government's share of GDP which can be estimated from the national flow of funds accounts. See Batson (2020) for details.

[3] Between 2003 and 2019, the number of groups under central SASAC fell from 187 to 97; over the same period, the number of subsidiaries and assets of these groups increased 2- and 4-fold, respectively.

A more microeconomic perspective

Differences at the sector and firm level parallel those at the macro level. In industry, the state pursued a strategy that maintained significant state control over critical "mature" sectors dominated by SOEs but lowered the barriers for nonstate firms in nonstrategic sectors (e.g., labor-intensive light industry). Foreign direct investment in newly established special economic zones (SEZs) was encouraged early on for the purpose of exporting, much of it through "processing" exports that did not compete with the SOEs. Leveraging China's comparative advantage, growth in exports in the nonstate sector was rapid over this period.

Success in nonstrategic sectors by non-state firms allowed for a steady flow of resources into the state sector in the form of preferential access to bank credit and foreign exchange, the latter used for technology licensing, the import of raw materials, intermediate inputs and new equipment, and expansion in capacity. Outside the SEZs, foreign firms often needed to partner with state firms in joint ventures (JVs), as, for example, in the case of the auto sector and in much of the machinery industry. Under the policy of "trading markets for technology," foreign firms were offered access to China's "protected" domestic market, but only if they complied with a series of complicated regulatory requirements designed to transfer technology and knowhow to local partners, usually SOEs and their suppliers.

Aggregate performance in China's manufacturing sector during this period was impressive. Growth averaged over twenty percent per annum. Even more telling, total factor productivity growth was the source of *more than half* of the total increase, on par with rates achieved by the manufacturing sector in other successful Asian economies (e.g., Japan, Korea, and Taiwan) at similar periods in their development (Brandt, Van Biesebroeck, and Zhang 2012).[4] Rapid productivity growth was instrumental in sustaining high returns to investment in manufacturing in the face of rapidly rising wages.

These huge gains were the product of firm-level efforts to lower costs, improve product quality, and move up the value chain.[5] Improvements were usually incremental (Breznitz and Murphey, 2011), as firms successfully moved from low to medium segments of the market (Brandt and Thun, 2010 and 2016). This dynamism is also reflected in the increasing sophistication of China's exports (Schott 2008) and the success of manufacturing firms in China—foreign and increasingly domestic—to capture growing market share in the highly competitive and demanding export markets in advanced countries (Mandel 2013). With the deepening of

[4] Estimates made by Brandt, Van Biesebroeck, and Zhang (2012) using the annual firm-level survey data of the National Bureau of Statistics (NBS) between 1998 and 2007 show that 57% of the growth in industrial output is a result of productivity growth.

[5] Estimates suggest that in the 10 to 15 years prior to the global financial crisis in 2007–2008, productivity at the firm level increased 2.8% and 8.0% per annum on a gross output and value-added basis, respectively, and at an even higher rate at the industry level.

capabilities in the Chinese domestic supply chain, domestic sourcing increased, as did the share of domestic value added in China's export sector (Kee and Tang 2017).

Analysis at the aggregate level once again conceals heterogeneity between sectors, and the influence of state policy. Productivity growth in state-dominated sectors upstream in the value chain, e.g. mining, petroleum refining, non-ferrous metals, lagged considerably, largely reflecting much weaker incentives for innovation and upgrading, less competition, and government influence over new firm entry, access to finance, and exit. Differences in productivity growth between sectors can be directly tied to falling barriers to entry, output tariff reductions that increased competition, and falling import tariffs that provided access to higher quality inputs (Brandt et. al, 2017; Amiti et. al., 2020).

A unique feature of China's productivity growth was the crucial role of new firm entry.[6] Significantly, the role of the reallocation of resources to more productive firms or firm exit is negligible. Capital market frictions are often cited as a major constraint on firm growth, but product market barriers, input subsidies for inefficient firms, and more generally, preferential treatment of politically connected firms impeded the growth of the best firms.[7]

We see similar differences within services. The more capital- and skill-intensive sectors such as finance, media, telecommunications, and transportation remained the preserve of state or state-connected firms, with limited inward FDI. These sectors were important for economic, political, and a combination of security and strategic reasons.[8] Estimates by the OECD on FDI restrictiveness in these sectors reveal highly restricted market access.[9] The more labor-intensive service sectors such as retail and wholesale trade and hospitality were much more open; they have also been left to absorb a growing share of the expanding labor force. Productivity growth in services however has lagged considerably that in industry which was much more open to competitive pressures. Competing state interests within services has also been more pronounced.

A key lesson from this experience was that sectors that were consistently most open to competition, in which entry and exit of firms was far less encumbered and, more generally, in which firms have been free from the all too "visible" and often distorting hand of the Chinese state at both the local and central level, are in fact those that have been most dynamic. They

[6] Productivity growth can be decomposed into four key sources: 1. improvements in existing firms; 2.a reallocation of resources to more productive of firms; 3. entry of better firms; and 4. the exit of poorly performing firms. Institutional barriers to entry and discrimination facing entrepreneurs fell significantly in many sectors. The higher productivity of new entrants relative to incumbents lifted overall productivity levels (Brandt, Kambourov and Storesletten, 2020).

[7] Interviews with firms over the years reveal cases of firms unwilling to make investments in R&D and new product development because of concerns over domestic market access, especially in sectors dominated by SOEs.

[8] For an excellent discussion of some of these issues in the context of the telecommunications sector, see Sturgeon and Thun (2019). Through 2015, network utilization rates remained very low (Interviews).

[9] These measures reflect *de jure* commitments to not discriminate and can differ from *defacto* discrimination.

are also the sectors in which Chinese firms were successfully competing in more demanding markets, domestic as well as overseas, and in which dynamic national champions emerged.

By contrast, those sectors that remained the preserve of the SOEs either exclusively, or occasionally through ventures with other types of firms; in which NDRC (National Development Reform Commission) or MIIT (Ministry of Industry and Information Technology) continues to influence sector dynamics through licensing and entry decisions, technology choices and investment, and regulatory behavior; and in which outcomes are often badly distorted by a combination of central government objectives and local governments incentives have usually failed to deliver dynamic local firms. They are also the same sectors, e.g. steel, shipbuilding, power generation, in which problems of excess capacity persist, despite repeated efforts administratively to deal with over-investment.

As the financial costs of supporting state sector firms and workers rose, the state significantly trimmed its commitment. By 2008, the share of the state sector in the gross value of industrial output (GVIO) fell to 36% in 2008, down from 58% in 1995. The share of firms classified as state-owned fell even more sharply, reflecting the huge sell off and often bankruptcy of the smaller SOEs in the late 1990s and early 2000s. After rising from 75 million to more than 110 million between 1978 and 1995, employment in the state sector also fell to 65 million by 2007.

China's Changing Strategy

Despite the success of the first three decades of reform, there were concerns within China's leadership and key segments of the policy-making community over China's future economic prospects. All of this preceded President, Xi Jinping. Several things are noteworthy.

In export industries, a common perception was that value added was relatively low, growth was tied to the supply of inexpensive labor from the countryside, and core technologies remained controlled by foreign firms.[10] Policymakers hoped that state intervention would lead to the development of national champions with their own brands and independent technological capabilities. Through the mid-2000s, foreign-invested firms in manufacturing in China became more, not less dominant, with their share of the domestic market and exports rising to one quarter and one-half, respectively.[11] In key sectors China failed to develop national champions—usually SOEs--that could compete with leading multinationals. Gains in market share by domestic brands in recent years were led largely by non-state firms.

This was perhaps most obvious in the auto sector – a sector that remains dominated by JVs between the leading multinational car companies, e.g. Volkswagen, Toyota, and General

[10] Some of this perception was tied to the role of processing exports. Recent estimates (Brandt, Morrow and Li, forthcoming) show that productivity growth in processing exports was on par with that of ordinary exports. Domestic value added in processing was also on the rise as domestic capabilities deepened.

[11] Adding imports to the output of FIEs in China sold domestically would increase the share of foreign firms in the domestic market. Although the share of FIEs rose, exports of domestic Chinese firms increased at a rate of 17 percent per annum.

Motors, and their state-owned counterparts such as First Auto Work (FAW) or Shanghai Automotive Industrial Company (SAIC). In the context of a protected domestic market, the expectation was that technology transfer through the JVs would lead to the development of independent capabilities in domestic Chinese car firms. This has not materialized. Critics of the "trading technology for market access" policies referred to the "JV mind-set" (合资主义). The combination of easy access to foreign brands and technology and the high profit margins that came with an oligopoly in the domestic market meant that the Chinese partners in the JVs had little incentive to invest in the development of independent technological capabilities.

Within China's science and technology community, there was a widespread belief that WTO accession had limited the policy tools that could be used as leverage vis-à-vis foreign firms.[12] Moreover, the royalties that Chinese firms were paying for technology imports were believed to be excessive, resources that could have been directed to local R&D (Cao et al. 2006, Serger and Breidne 2007).[13] Policymakers also perceived an emerging opportunity in nascent industries and new cutting-edge technologies. According to China's Ministry of Science and Technology in 2005, Chinese firms would be able to seize a leadership position by aiming "at the forefront of world technology development, intensify[ing] innovation efforts, and realiz[ing] strategic transitions from pacing front-runners to focusing on 'leap-frog' development in key high-tech fields in which China enjoys relative advantages (cited in Applebaum, Parker et al. 2011)."

An increasingly top-down approach to technology and innovation, reminiscent of that of pre-reform China, resurfaced in the mid-2000s. As Heilman and Shih (2013) document, China implemented national industrial policies as early as the 1980s, but these were typically limited in coverage, i.e. usually focused on a single sector, and few in number until 2004. A more comprehensive top-down approach was given the imprimatur of China's top leadership in January 2006, when President Hu Jintao announced a 15-year "Medium- to Long-term Plan for the Development of Science and Technology" (MLP).

The MLP identified both priorities (including 11 key areas relating to national needs, 8 areas relating to frontier technologies, and 13 engineering megaprojects), institutional reforms that were designed to improve the management and implementation of S&T policy, and a policy framework that was designed to reduce China's dependence on foreign technology. These policies were more comprehensive than in the past, the resources committed were far greater and the focus on *independent* capabilities was more central. The objective of the MLP was to make China an "innovation-oriented society" by 2020, and a world leader in science and technology by 2025. The much stronger fiscal position of the central government and the huge flow of savings through the state-dominated financial system helped make this possible.

[12] At the same time, China often took actions to undo the competitive effects of falling tariffs and non-tariff barriers mandated by WTO accession on domestic firms.

[13] There were dissenting voices——economists argued that technology transfer from foreign firms continued to be the most cost-effective means of upgrading, while scientists argued that the top-down approach led to funding decisions that were biased and inefficient (Cao, Suttmeier et al. 2006)— but these were in a minority.

The Global Financial Crisis of 2008 strengthened the new policy direction in two key respects. First, the failure of Western institutions leading up to the crisis, and disarray following the crisis, bolstered the belief of Chinese leaders that a "China model" of development, combining authoritarian rule with state-led economic development, was preferable to the liberal democratic model (Zhao 2017).[14] China's policy response to the crisis—which Nicholas Lardy (2012, pg. 5) called "early, large, and well designed"—was widely credited with playing a critical role in preventing an even more severe global crisis. Second, the massive stimulus plan of 4 trillion RMB ($586 billion) was channelled in many cases through the state sector and hence enhanced the role of state firms vis-à-vis private firms.[15]

A second wave of policies was issued in 2010, when the Five-Year Plan on Strategic and Emerging Industry (SEI) committed US$1.6 trillion to seven emerging technologies: energy saving and environmental protection, next-generation information technology, biotechnology, advanced equipment manufacturing, new energy, new materials, and new-energy vehicles. This was followed by Made in China 2025 in 2015, a comprehensive plan focused on fostering Chinese leadership in key high-technology sectors that was prepared by the Chinese Academy of Engineering. Through import substitution, massive government spending, and tighter restrictions on foreign firms, the policy seeks to aid Chinese firms in their effort to capture the high value-added activities in global value chains. A key aspect of the plan is "indigenous innovation" and "self-sufficiency" for "basic core components and important basic materials." Semi-official documents related to the plan outline concrete localization benchmarks that are to be achieved in targeted sectors by 2025 (Wubbeke, Meissner et al. 2016). China's 14th FYP provides additional details and direction, as does China Standards, 2035.

Economic Implications of China's Changing Strategy

The shift in strategy has implications for the direction and speed of China's technological upgrading, China's ties to the rest of the world, and economic growth. We examine each briefly in turn with a focus on growth and its possible links to the policy change.

Technological Upgrading

Assessing the upgrading of capabilities at the firm or industry in China is inherently difficult. In some industries, e.g. semiconductors, solar panels, steam turbines, there are often well-defined metrics that help in the technical benchmarking, but in others, e.g. AI, it is more difficult. Focusing on a product such as a handset, a computer chip, or wind turbine also has limitations – analysis at this level ignores the critical role of the capital equipment, intermediate inputs, IP, and software in the value chain, inputs that are often externally sourced. Core design tasks are also often left to international partners through JVs or licensing agreements. Even in a product

[14] The idea of a "China model" is one that has evolved over time and has alternative interpretations. Zhao (2017) provides a good overview in the introduction to a special issue on the topic in the *Journal of Contemporary China*.
[15] See Lardy (2018), pp. 11-13 and pp. 33-41, on this point.

such as the internal combustion engine (ICE) car, seventy percent or more of the IP resides with the OEM's suppliers. In addition, technical upgrading does not always translate into commercial success.

In China, we see a mixture of outcomes: technological upgrading accompanied by rising market shares in domestic and international markets; technical upgrading in which much of firm and industry expansion appears to rest on government support; technological and commercial failure as costs escalate and market opportunities fall short of expectations; and finally, cases of "successful" failure in which long run gains are believed to outweigh any short-terms losses. In China, we see all of the above. A few examples are helpful. Aggregating these effects up to the aggregate level is difficult, however.

Power Transmission

China's difficulties in civil aviation and semiconductors through prominent state-owned enterprise groups have been well-documented. In contrast, State Grid (State Grid Corporation of China, or SGCC) has become the world leader in ultra-high voltage (UHV) long distance power transmission, a technology identified in the 2006 MLP for S&T (Xu, 2019). Although a relatively "mature" technology" that several countries had previously tried to implement, at the end of the last century, there were no lines in commercial operation. Overcoming both domestic economic and political opposition, State Grid appealed to policymakers for support on two grounds: first, success would help establish the State Grid as an internationally competitive technology leader; and two, the technology would be key in the transition to low-carbon electricity. In addition, there were important spillover effects in basic R&D, materials and equipment manufacture. The SGCC has successfully built UHV lines connecting the renewable-energy rich western China with the rest of China, as well as in Brazil.

Heavy Construction

China's domestic heavy construction equipment sector, a sector that has been relatively open to inward FDI, private sector entry and competition, has experienced considerable success over more than three decades, largely in the context of a rapidly domestic market (Brandt and Thun, 2010 and 2016). Chinese firms initially succeeded in the lower end of the domestic market, e.g. wheel loaders, but later successfully moved into more demanding products such as excavators the markets for which had been dominated by the multinationals such as Caterpillar, Volvo and Komatsu. An in-depth analysis of the sector (CLSA, 2013) attributed this success to the ability of Chinese firms, private and SOEs, to compete on the basis of both price and quality in medium-market segments. In a test of 13 leading excavator brands in China in the mid-size excavator market (20–25 tons), performed over 185 working hours during a two-week period in 2013, CLSA found that "*technology gaps are non-existent* between top-tier Chinese and international companies."

The contrast with the ability of the domestic auto OEMs to compete with the leading JVs in China is sharp. A study of the auto sector carried out in the same year as the heavy

construction equipment study concluded: "The leading Chinese products now have bodies, safety and suspension hardware that are largely competitive. But they are behind on engine technology and are also let down by assembly standards, material choices, systems integration, refinement, and a lack of final development and testing. *They are still a long way from being genuinely 'world class.'*" (Warburton et. al 2013).

Solar

After taking off in the mid-2000s, China's solar sector has become the world's largest. The industries' growth has been distorted by government policy, but the industry's success is not because of government policy. A case can also be made that better domestic firms in the industry have *on net* actually been handicapped by government policy.

Much of China's expansion in the sector has been based on the absorption and improvements of a relatively mature first-generation solar panel technology. Domestic firms actually resisted some of the push of 2nd- and 3rd-generation technologies. Manufacture of panels using 1st-generation technology involves four highly discrete activities that can be carried out independently. Experts put the barriers to entry slightly above those for LED lighting, but much lower than semi-conductors, two other products based on silicon. Much of the initial critical know is embedded in equipment; China was also able to import turnkey equipment for key stages in the value chain. It also benefitted from returning overseas Chinese who helped to start local firms. Initially, in line with their comparative advantage, Chinese firms concentrated in the labor-intensive, downstream stages, sourcing globally key equipment, components and materials. But over time, they were highly successful in entering and occupying prominent positions in all segments of the value chain, at the same time as which domestic content rose.[16] Localization in the supply chain was facilitated by the technological complementarities throughout the value chain with other sectors in China. Demanding quality standards in export markets, the destination of most domestic production initially, meant that local sourcing could increase only as long as quality standards could be maintained.

Telecommunications

In the late 1990s, the China Wireless Telecommuncation Standard Group proposed TD-SCDMA to the International Technology Union as part of a call for 3G standards. China's bid was motivated by a desire to rapidly deepen technological capabilities in Chinese firms, but also to reduce licensing and IP costs as Chinese firms contributed more IP to the new technology standard. Use of the Chinese standard would also facilitate market sales outside China. National security concerns also figured prominently. With the adoption in 2000 of TD-SCDMA as one of the 3G global standards, huge government support followed. But interests between state telecom carriers, handset firms, and equipment manufacturers and chipset suppliers—all essential to the network--were often not aligned. As development and implementation were

[16] Between 2006 and 2014, imported intermediates as a share of total intermediates in the sector fell from 89.7% to 43.7% (Brandt and Wang, 2019, Table 9.4).

drawn out, costs rose, and immediate benefits fell. Perspectives on the experience differ. The more positive assessments view TD-SCMDA as a critical stepping-stone to China's even larger role in the development of 4G standards. Others are more cautious but argue that a weak version of the "successful failure" argument is hard to refute (Sturgeon and Thun, 2019). Assessing the benefits of the counterfactual are also difficult.

Ties with the Rest of the World

China's shifting ties to the rest of the world are reflected in the growth and composition of its exports and imports, the role of foreign-invested firms in China, as well as China's inward and outward FDI. Since the mid-2000s, the role of China's domestic market and domestic firms in that market have become more dominant as inward FDI into manufacturing became less salient; at the same, trade flows with emerging markets have increased in both absolute and in relative terms.

Table 1 reports the growth of Chinese exports (reported in $US) for the years between 1992 and 2019 and select sub-periods. Over the full 27-year period, Chinese exports grew by more than 13.3 percent per annum as China's share of global exports increased from less than 2 percent to nearly 13 percent. Export growth accelerated with WTO Accession, increasing from an annual rate of 14.4% between 1992-2000 to 25.5% between 2000-2007. Subsequently, export growth slowed, and between 2013-2019 averaged only 2.1 percent per annum.[17] Some of this decline reflects global trends and factors external to China, e.g. deglobalization and slower global economic growth, but a case can be made that a significant portion of the decline is a product of internal factors weakening Chinese export competitiveness (Brandt and Kim, 2021). If so, policy in China may be having much larger global implications than typically believed.

Changes in export growth have been accompanied by changes in the composition and the destination of Chinese exports. Early in China's opening, textiles and apparel dominated, and by the early 1990s represented more than 40 percent of China's total exports. The end of the Multi-Fiber Agreement (MFA) was a powerful liberalizing force for the domestic sector (Khandewal, Schott and Wei, 201x); however, the share of textiles and apparel in China's exports fell sharply through the mid-2000s, before leveling off at fifteen percent or so. Significant, but much smaller reductions were experienced in the export shares of three resource-based sectors, namely, food processing, wood products, and leather goods. These reductions were largely offset by the rapidly rising share of machinery which rose from 18 to 45 percent of total exports, and much smaller increases in transportation and rubber and plastics.

Table 2 provides a breakdown of the destination of Chinese exports for select years between 1993 and 2019. Exports to North America, Europe, and East Asia largely represent exports to

[17] Some of this reflects the disruption to trade with the US in 2019. Between 2013-2018, the increase was only 2.4 percent.

advanced, higher income countries, with the rest of China's exports going to emerging economies. Note the significant, albeit falling share to HK, much of which is then re-exported to other countries. We report the share of exports going to advanced countries; the share to advanced countries plus HK; and finally, the share going to advanced countries plus a proportion of those to HK that also likely ended up in advanced countries.[18] Since the 2000s, the share going to advanced countries has steadily declined by a total of 16 percentage points. Exports to almost all other emerging economies have expanded. Especially noteworthy is the rapid rise in the share going to South and Southeast Asia which rose by nearly 10 percentage points.

Foreign presence in the Chinese economy, an important source of both new knowhow and competition through the first three decades, now appears to be diminishing. We look at this from several perspectives. Table 3 provides data on inward FDI flows for select years between 1990-2019. Over time, FDI into China has increased in absolute terms. But measured as a percentage of either Chinese GDP, or as a % of total annual gross domestic capital formation, its role has fallen sharply. In 2019, FDI into China was only 2.2% of total gross domestic capital formation. Over the same period, China's outward FDI has increased and now equals the inflows.

Paralleling these trends is the changing importance of foreign-invested firms in China's manufacturing sector. Between 1992 and 2006, foreign-invested firms' share of China's exports rose sharply from 20.9% in 1992 to 56.6%. Over the same period, these firms succeeded in capturing a rising share of the domestic market, which peaked at a quarter in the mid-2000s. Subsequently, both shares began to fall, and by 2018 FIE's share of exports dropped to 41.6%. One factor responsible for the decline is the fall in the number of FIEs. In 2018, the number of foreign-invested firms in China's manufacturing sector was actually less than it was in 2008, a decline experienced in almost all 2-digit manufacturing sectors. The winners were China's private domestic firms, whose share of exports surpassed one-half by the end of this period. China's SOEs figure only marginally in the picture here. Their role in exporting has been very modest and currently they are the source of only 5% of exports.[19] Their share of the gross value of industrial output (GVIO) also continued to decline over this period (Lam and Schipke, 2017).

Growth and Productivity

Although China was able to buffer the domestic economy from the immediate shock of the Global Financial crises, economic growth has slowed. China's reported growth figures since 2008 or so may also be over-estimated by 1.5-2 percentage points per year (Chen et. al. 2019; Hu and Yao, 2019). Perhaps even more significant, the contribution of productivity growth to

[18] We assume that the proportion of exports to HK that are destined for advanced countries is equal to the share of the rest of Chinese exports that go to advanced countries. This implies that the composition of China's and HK's exports are similar. More work is required to confirm this.

[19] SOEs play an important role as trade intermediaries however, with a third of trade through state-owned trading companies. They are much less important as manufacturers of exports.

aggregate GDP growth has largely disappeared, in sharp contrast to the experience before 2007. This implies that growth is largely coming from the extensive margin and capital deepening (Bai et. al. 2017; Brandt et. al., 2020; Dollar, 2016). This links the marked slowdown in Chinese growth to the behavior of productivity. As returns to capital formation in the business sector have fallen, much of the increase in investment has been in infrastructure and housing, two sectors that the state exercises considerable influence over. The last ten years, the incremental capital-output ratio in China has nearly doubled.[20]

The reason for the pronounced decline in productivity growth is open for debate. Productivity growth has also slowed in advanced countries (Gordon, 2016), but the gap in productivity between China and these countries—a measure of remaining economic potential—remains on the order of fifty percent or more. Policy choices and the more visible hand of the state in China described earlier may be at the core of a decline that appears to be widespread.

There is a temptation to link this to an expanding state sector in the economy. But, in the aftermath of the Global Financial Crises, the share of state-owned firms in the non-financial sector has remained relatively constant at twenty percent of GDP (Batson, 2020). This limits how much of the decline in aggregate productivity growth can be directly attributed to falling productivity growth in the state sector. It also suggests that the most important reason for the decline in growth is falling productivity growth in China's private sector. As important as ownership may be for how well the Chinese economy performs, far more important is the entire regulatory and policy environment facing firms, state and nonstate alike.

In manufacturing, the contribution of new firm entry, an especially important source of productivity growth early on, has largely disappeared. After falling sharply through the mid-2000s, barriers to entry may be on the rise again. On the other hand, product and factor market imperfections appear to be impeding the reallocation of labor and capital to the best firms, an important source of productivity gains. Following the Global Financial Crises, the share of new credit going to private sector firms has fallen precipitously (Lardy, 2018). Restructuring and bankruptcy of poorly performing firms continues to face administrative hurdles. As a result, problems of excess capacity persist in a long list of traditional industries, e.g. steel, cement, aluminum, flat glass, automobiles and shipping, but now also in newly emerging industries such as renewable energy (solar and wind) and EVs. Utilization rates in power generation are also at historical lows, reflecting both weakened demand, and capacity expansion. The NBS reports annual estimates of capacity utilization for all of industry. After rising through the mid-2000s, capacity utilization rates fell and at the end of 2019 were at historic lows.

Findings from a recent study (Barwick, Jia and Kaloupsidi, 2021) of China's shipbuilding industry may be typical of these industries. The industry was identified as "pillar" in both the 11th (2006-2010) and 12th (2011-2015) Five-Year Plans, and the beneficiary of a long list of national policies

[20] The incremental capital-output ratio is the amount of capital it takes to produce an additional unit of output in value terms. A rise in the ICOR reflects a decrease in investment efficiency and productivity. See Herd (2020).

designed to elevate the industry to a global leader. Explicit targets were set for output and capacity. Subsidies were extended for firm entry, and separately for production and investment. Top-down consolidation was also carried out. Between 2006 and 2016, China's share of the global shipbuilding industry increased from 15 percent to more than half. The authors show the important role of subsidies, which totaled $US 90 billion between 2006 and 2013, in explaining this behavior. Because the subsidies were generally extended to inefficient and unproductive firms, industry profits declined, and problems of excess capacity were exacerbated. Lower efficiency of Chinese shipbuilders relative to their foreign counterparts also suggests a misallocation of resources globally.

In much of the capital and skilled-labor intensive services such as finance, media, telecommunications, and transportation, sectors that are strategically critical to China, state-owned firms continue to dominate. Private firms are much more prominent in information technology, e-commerce, software, and fin-tech, but even in these sectors dynamism may be affected by the market power enjoyed by leading fells, as well as state policy choices. Political pressure on these firms under Xi Jinping also appears to be rising (Bloomberg, 2021). More generally, the overall effect of the ITC sector on productivity, either within the service sector, or outside, so far appears to have been marginal. The likely long-run benefits are also open to debate.

In the context of China's technological upgrading, much is made of the rising share of GDP directed to R&D in China, as well as the huge increase in patenting activity. Between 2001 and 2011, for example, patent applications to the State Intellectual Patent Office (SIPO) grew 30 percent a year. Over the same period, R&D expenditure as a share of GDP rose from 0.9 to 1.8 percent.[21] By 2018, it hit 2.2 percent, with even more ambitious targets set for the next decade.

Not all of this increase in activity should be dismissed, but consistent with the behavior of productivity since the Global Financial Crises, there is reason to believe that policy may be distorting these choices, lowering returns in these activities in the process.[22] The association between patents and R&D, as well as between patents and labor productivity have weakened, consistent with the view that the patenting surge is tied to "non-innovation" related forces (Hu et. al., 2017; Putnam et. al. 2020). Measures of patent quality also suggest significant differences in patent quality between China and advanced countries (Boeing and Mueller, 2018). Returns to R&D in China also appear to be falling, and more rapidly than they are globally (Boeing and Hunermund, 2020). Equally telling, a new study (Han et. al., 2021) using patent citations to look at the technological linkages between the US and China reveals an

[21] https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=CN

[22] The Chinese government is equally interested in these same issues, and earlier this year announced plan to cancel patent subsidies. See https://www.chinamoneynetwork.com/2021/02/02/china-cancels-patent-subsidies-in-effort-to-boost-innovation

important shift. After “dependence-deepening” integration with the US through 2009, the next decade featured the exact opposite, namely, “dependence-declining”. Moreover, towards the end of their sample (after 2018), they observe signs of increasing decoupling, but caution that the time period is too short to make definitive conclusions.

Looking forward

In the near to medium term, the costs of these policies may multiply as China benefits much less from the global linkages and competition that were helping to drive innovation and growth, and as policies undermine the bottom up changes that were the source of dynamism. A declining labor force as well as a fall in the rate of savings and investment will make these choices even more salient.

On the margin, policy makers will try to limit these costs with incremental reforms – we already see some of this – but these are likely to be modest and will not eliminate the fundamental tensions that currently exist between the economic and political objectives of the state.

Recommendations

Policy choices in the US need to be made on the basis of accurate assessment of the strengths and weaknesses of the Chinese economy. Current narratives both over-estimate as well as under-estimate. These assessments are also often handicapped by serious data limitations and a lack of deep knowledge of policymaking in China.

1. Congress should insist on rigorous assessments of the Chinese economy that reflect the difficulty of such a task.

How policy matters in China at the firm, sector, and aggregate level for technological upgrading, productivity and growth often remains a black box. Huge gaps also exist in our knowledge of how these same policies are often influencing global industry outcomes, including global market structure. There are significant returns to making such assessments, carefully cataloguing policy choices that often cut across industry lines.

2. Congress should ensure that policy choices are made on the basis of accurate assessments of the costs and benefits of policies implemented in China.

Top-down, centrally directed industrial policy of the sort now used in China has become fashionable again in some circles. Governments can and should play an important role in encouraging innovation and technological development, and in protecting national security interests, but the economic costs of the type of strategy China is pursuing are becoming clearer.

3. Congress should ensure that national security interests are protected, but also provide an economic environment conducive to innovation and technology development that will be the source of future productivity growth.

China's new strategy runs the risk of bifurcating the global economy over the long run in ways that have important long-run economic and strategic considerations. How countries, advanced as well as emerging, will be affected differs significantly. Interests of these countries will not always be perfectly aligned with the US. In the past, China has used a combination of narrow bilateral and regional agreements to conquer and divide. Broad multilateral agreements are key to counteracting this.

4. Congress should support US leadership over multilateral global trade and investment reform. In doing so, it must be prepared to accommodate broad interests in order to secure agreements that span both advanced and emerging economy. At the same time, it should resist excessive influence by narrow, albeit well-organized US interests that China often plays to.

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Table 1: China's Annual Export Growth

Period	Annual Growth
1992-2000	14.4%
2000-2007	25.5%
2007-2013	10.4%
2013-2019	2.1%
1992-2019	13.3%

Source: Computed from UNCOMTRADE Data. Exports are expressed in $US.

Table 2: Destination of Chinese Exports, 1993-2019

Destination	1993	2000	2007	2013	2019
North America	22.1%	23.4%	21.2%	18.7%	18.7%
Western Europe	14.1%	16.2%	18.6%	14.0%	14.9%
East Asia	17.0%	19.8%	12.5%	11.0%	10.0%
South East Asia	6.3%	8.1%	9.1%	12.6%	15.7%
Eastern Europe & Russia	4.2%	2.6%	5.9%	5.4%	5.6%
Middle East	2.8%	3.1%	4.7%	5.3%	5.1%
Central & South America	1.6%	2.6%	3.7%	5.7%	5.5%
South Asia	1.4%	1.3%	2.8%	3.4%	4.6%
Africa	0.6%	1.2%	2.0%	2.8%	2.7%
HK & Macau	26.3%	18.2%	15.2%	15.9%	11.1%
ROW	3.5%	3.6%	4.2%	5.3%	6.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

Adv Countries	53.2%	59.4%	52.3%	43.6%	43.7%
Adv + HK	79.5%	77.6%	67.5%	59.5%	54.8%
Adv + % of HK	72.2%	72.6%	61.7%	51.9%	49.1%

Source: Computed from UNCOMTRADE Data.

Table 3: FDI Flows

FDI inflows, 1990-2019

(Millions of dollars)

	1990	1995	2000	2005	2010	2015	2019
World	204,886	345,143	1,356,611	947,706	1,396,203	2,041,770	1,539,880
China	3,487	37,521	40,715	72,406	114,734	135,577	141,225
China, %	1.70	10.87	3.00	7.64	8.22	6.64	9.17
FDI inflow as % of GDP	0.88	5.11	3.36	3.17	1.88	1.23	0.98
FDI inflow as % GDCF	3.60	15.39	10.05	7.82	4.18	2.80	2.24

FDI inward stocks, 1990-2019

(Millions of dollars)

	1990	1995	2000	2005	2010	2015	2019
World	2,196,202	3,564,447	7,377,272	11,431,253	19,922,422	26,577,573	36,470,162

China	20,691	101,098	193,348	272,094	586,882	1,219,930	1,769,486
China, %	0.94	2.84	2.62	2.38	2.95	4.59	4.85
FDI Inflow Stock as % of GDP	5.24	13.76	15.96	11.90	9.64	11.08	12.32

Notes: GDP is gross domestic product; GDCF is gross domestic capital formation.