China's Position in Global Supply Chains: Understanding the Effectiveness of Industrial Policy

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I. Introduction

China has become a central actor in global value chains (GVC), accounting for nearly 20% of global manufacturing trade and a far greater share of many intermediate GVC inputs that are essential for modern production. As China's position in global value chains has strengthened, so have concerns about America's domestic vulnerabilities.

The following testimony seeks to explain China's supply chain dominance through an understanding of the efficacy of China's industrial policies, with specific attention to policy implementation by local governments and firms themselves. Broadly, I argue that China's dominance in global supply chains has been driven by China's comparative advantages regarding size, geography, and human capital rather than by intentional industrial policy (Section II). Industrial policy, which has become increasingly important in the past 10-20 years in China, has had limited effectiveness due to mismatched incentives between central government policymakers and local government policy implementers (Section III). Yet in certain sectors, particularly emerging industries without global incumbents, Chinese policy has found more success. This variation in sectoral outcomes is explored through examples drawn from the Biden Administration's Executive Order 14017 exploring U.S. supply chain resilience, including rare earth elements, semiconductors, and high-capacity battery production (Section IV).

The testimony concludes with a set of policy recommendations for the U.S. government based on the preceding analysis (Section V). Most importantly, U.S. policymakers should not base policy on overestimation of the threat from China: China's low-cost production has benefits for the US; China remains more vulnerable to U.S. economic coercion than vice versa, and is thus unlikely to use supply chain disruptions for political gain; the biggest risk for American companies is losing China as an export market, *not* being denied Chinese inputs; and, most importantly, changes in risk perceptions and rising costs in China have already altered China's comparative advantage and encouraged companies to move production away from China without policy encouragement. Beyond this broad conclusion, however, U.S. policymakers should address emerging vulnerabilities through limited and highly targeted supply chain support; greater global trade integration and renewed efforts at WTO reform to pressure reforms to Chinese trade practices; and

continued societal openness to ensure that China's best and brightest minds continue to study and work in the United States.

II. China's supply chain evolution

From 1978 until the global financial crisis in 2008-2009, China transitioned from a nearly autarkic country to the world's largest manufacturer and goods exporter. China's deep integration into global supply chains in this period was enabled by serendipitous *timing* given concurrent global developments, East Asian *geography*, natural *comparative advantage*, and *policy choices*, particularly trade and market liberalization. During this period, industrial policies to strengthen China's position in global supply chains were limited in scope and effectiveness.

Timing

China's entry into the global trading system from 1978 through 2008 coincided with a new wave of globalization and global value chain development driven by the information and communications technology (ICT) revolution and declining transportation costs. The ICT revolution significantly lowered costs of outsourcing and related services, including financial services, computer and information services, and other business services, which could increasingly be traded internationally. Technological developments in transportation led to lower costs for air and ocean shipping.[1] These declining costs helped to spur firm de-verticalization and outsourcing. Rather than fully integrated vertical firms, business shifted towards lead firms with core competencies, with production increasingly moving out-of-house in the 1980s and 1990s. Declining costs also led to a "death of distance." Previously, countries predominantly traded with their neighbors, e.g., intra-regional trade in Africa and the Middle East, or with large geographic players, e.g., the U.S. in Latin America and Russia in Eastern Europe, but lower costs and integrated value chains defied this "gravity"-based explanation for trade.

Based on these trends, goods trade in the 1980s and 1990s soared, outpacing global GDP growth two-fold. China was particularly well-positioned to capitalize on these trends given the concurrent launch of China's opening and reform period in 1978.

East Asian geography

China's centrality in an increasingly integrated East Asian region facilitated China's entry into global supply chains. East Asia has led the way globally in terms of explicit support for developing regional value chains, as trade policies have consistently ensured low tariffs on intermediate goods through a rapid increase in regional preferential trade agreements (PTA), which expanded from 3

[1] Hummels, D. 2007. "Transportation Costs and International Trade in the Second Era of Globalization." *Journal of Economic Perspectives* 21(3):131–54.

in 2000 to 37 a decade later, with a further 72 under negotiation.[2] China took full advantage of these PTAs, implementing 13 PTAs with 21 individual economies and negotiating at least 10 more, including the 16-member Regional Comprehensive Economic Partnership (RCEP). And GVC complementarities have been an important factor in determining China's choice of PTA partner.[3]

China's geographic centrality within Asia also played an important role given the extensive regional Chinese diaspora. Early foreign direct investment (FDI) into China in the 1980s and 1990s was driven by investment from Hong Kong, Taiwan, Singapore, and other Asian neighbors with large ethnic Chinese populations, constituting a "China circle." As industrial production in the East Asian "tigers" moved up the value chain, China became the natural destination for outsourcing given these language and cultural ties.[4] In this sense, much of China's rising GVC integration should be considered as relocated intra-Asian Asian trade. As one potential indication of this, the U.S. total goods trade deficit with Asia in 2000 was 2.6% of U.S. GDP, of which nearly 2 percentage points were accounted for by non-China Asia and less than 1 percentage point was accounted for by China; by 2016, the total U.S. goods trade deficit with Asia was 2.8% of U.S. GDP, but China accounted for nearly 2 percentage points of this deficit and non-China Asia accounted for less than 1 percentage point.

Comparative advantage: a relatively educated low-cost workforce

Centrality in East Asia only mattered given China's comparative advantages: most importantly, a large, relatively well-educated, and low-cost workforce. Mao era (1949-1976) policies, despite causing economic inefficiency and human disasters, also led to considerable increases in human capital: life expectancy rose from 40 years to 68 years and literacy rose from 10% to 90%, both well above other countries at China's level of per capita income, and the population itself grew from 540 million to nearly one billion.[5] Consequently, China entered the 1980s with a massive and relatively well-educated work force. Additionally, Mao policies restricting urbanization beginning in the late 1950s resulted in over 80% of the population remaining underemployed in rural areas, leading to a huge surplus rural labor population that could migrate for work to urban areas without driving up wage pressures.[6] Along with an urban workforce with higher levels of education, China thus had an ideal combination of supervisory manpower and a vast pool of

[2] Kimura, F., and A. Obashi. 2011. "Production Networks in East Asia: What We Know So Far." ADBI Working Paper 320, Asian Development Bank Institute; Escaith, H., and S. Inomata. 2013. "Geometry of Global Value Chains in East Asia: The Role of Industrial Networks and Trade Policies." In *Global Value Chains in a Changing World*, edited by D. Elms and P. Low, 135–57. Geneva: World Trade Organization.

[3] Cheng, D., X. Wang, Z. Xiao, and W. Yao. 2016. "How Does the Selection of FTA Partner(s) Matter in the Context of GVCs? The Experience of China." Working Paper, Fudan University, Shanghai.

[4] Naughton, B. 1997. *The China Circle: Economics and Electronics in the PRC, Taiwan, and Hong Kong*. Washington, DC: Brookings Institution Press

[5] Jowett, A. J. 1984. "The Growth of China's Population, 1949-1982 (With Special Reference to the Demographic Disaster of 1960-61)." *The Geographical Journal* 150(2): 155–70.

[6] China's "Lewis Turning Point"—the point at which surplus rural labor disappears and wage pressures start to grow more rapidly—did not occur until the past decade, although estimates of the exact transition timing vary.

unskilled workers. As a sign of the importance of low-cost labor, China's labor-intensive exports as a share of total exports rose from 37% in 1984 to 54% in 1994.[7]

In addition to China's well-educated yet cheap labor force, China's huge size and relatively well-developed infrastructure (see below) also provided firms with the option to relocate production within the country. This was particularly important given that GVC development and firm de-verticalization partially reshuffled global comparative advantages in trade, as GVCs required the capacity for inter-industry reallocation of inputs as well as the ability to support the operations of multinational firms.[8]

Policy choices: market liberalization and targeted support for export processing

Yet the single most important factor in China's global trade dominance has been the productivity gains enabled by state-owned enterprise (SOE) reform and private sector entry in the 1990s and 2000s, and this market liberalization was itself enabled by earlier trade liberalization. In this sense China's most important policy choices were to support market-driven growth.

On trade liberalization, in the 1980s China began to de-monopolize its Mao era foreign trade regime, under which the currency was entirely non-convertible, only 12 foreign trade corporations (FTC) were allowed to conduct cross-border trade, and an export plan covered all of China's exports. Gradually, ministries, local governments, and special economic zones were allowed to set up FTCs, and by the late 1990s China had granted direct export/import rights to 10,000 manufacturing companies.[9] By 1991, only 15% of exports were covered in the plan. And from a highly overvalued currency, China in the mid-1990s moved to a market-based currency convertible on the current account. At the time, China replaced non-tariff administrative barriers to trade with high tariffs, but over the course of the 1990s these high tariffs were reduced below the developing country average to pave the way for WTO liberalization.

Trade liberalization also included explicit policy choices to attract FDI and engage in export processing, but for the most part these policies were broad-based and not targeted at the development of specific industries. Policymakers established four SEZs in Guangdong and Fujian in 1979– enclaves that did not threaten China's system of domestic production—followed by 14 open cities in 1984 and a 1986 Coastal Development Plan with explicit support for export processing that brought SEZ-type policies to China's entire coastal region, with hundreds of millions of potential workers. Export processing was exempt from duties on imported inputs, providing an important cost advantage. And foreign invested enterprises (FIE) did not have to go

[7] Naughton, B. 1996. "China's Emergence and Prospects as a Trading Nation." Brookings Papers on Economic Activity, No. 2. Washington, DC.
[8] Amador, J. and S. Cabral. 2016. "Global Value Chains: A Survey of Drivers and Measures." *Journal of Economic Surveys*, 30: 278-301.
[9] See discussion in Naughton, B. 2018. *The Chinese Economy: Adaptations and Growth, Second Edition.* Cambridge, MA: MIT Press.

through FTCs to import, while also receiving special tax concessions. China's export processing trade subsequently reached as high as 56% of total exports by 1996.[10]

Beyond SEZs and export processing tax break policies—policies which China learned from Asia and the rest of the world—explicit attention to infrastructure development and to decentralization helped to attract FDI. China spent lavishly on infrastructure, including roads, railways, ports, and telecommunications; by the mid-2000s, despite remaining a lower middle income country, China's infrastructure stock was similar to advanced economies, and China's logistics performance rose well ahead of other middle income countries.[11] Part of this infrastructure performance was driven by competition between local governments to attract investment: in the 1980s, China developed a regionally decentralized form of authoritarianism in which local officials were incentivized to attract FDI to boost economic growth and thus their career prospects. Localities competed with each other by providing preferential policies including cheap land and tax breaks, and also by improving local institutions. This led to uncoordinated competition, as well as intra-national cross-border protectionism. But it also led to institutional improvements, as foreign firms were attracted to Chinese cities with more reliable contract enforcement and faster customs clearance.[12]

These policy reforms paved the way for foreign firms to help drive China's initial export explosion. The FIE share of exports rose from nothing in the late 1970s to 58% in 2005.[13] FIEs grew to account for 80% of processing trade and over 80% of China's high tech exports. American firms have been part of this process, but they have not been the key players, and their role has diminished in the past two decades. Although U.S. firms accounted for over 10% of China's inward FDI in 2000, this share has been below 2% since 2011,[14] partially due to the sectoral transformation away from manufacturing, whose share of manufacturing fell from 70% in 2005 to 25% in 2017, and partially because an increasing share of FDI is for domestic sales within China: domestic sales of FIEs surpassed export revenues in 2005 and were 2.7 times exports by 2013.[15]

FDI helped drive China's growth,[16] but trade liberalization's most important contribution was inducing international competition that forced deep reforms to China's enterprise system, enabling the entry of private sector firms and the closure of inefficient SOEs. During China's China's most rapid period of economic growth in the early 2000s, productivity gains across manufacturing sub-sectors were systematically correlated with levels of tariff reductions; sectors with greater tariff reduction experienced more private sector entry and greater competitive pressures that resulted in

[10] Ibid.
[11] Arvis, J.-F., M. Alina Mustra, J. Panzer, L. Ojala, and T. Naula. 2007. *Connecting to Compete 2007: Trade Logistics in the Global Economy--The Logistics Performance Index and Its Indicators.* Washington, DC: The World Bank.
[12] World Bank Group, IDE-JETRO, OECD, UIBE, and World Trade Organization. 2017. *Global Value Chain Development Report 2017: Measuring and Analyzing the Impact of GVCs on Economic Development*. Washington, DC: The World Bank.
[13] Lardy, N.R. 2014. *Markets over Mao: The Rise of Private Business in China*. Washington, DC: Peterson Institute for International Economics.
[14] Based on data from China Statistical Yearbooks, National Bureau of Statistics, various years.
[15] Enright, M.J. 2017. *Developing China: The Remarkable Impact of Foreign Direct Investment*. Abingdon and New York: Routledge.
[16] For a meta-analysis of FDI's contribution to Chinese growth, see: Gunby, P., Y.H. Jin, and W.R. Reed. 2017. "Did FDI Really Cause Chinese Economic Growth? A Meta-Analysis." *World Development* 90: 242-255.

improved SOE performance.[17] Trade liberalization also helped to improve China's institutions, as WTO accession spurred China to abolish, revise, or introduce more than 300 national laws and nearly 200,000 local regulations; such institutional reforms further helped to provide secure property rights for private and foreign firms. Consequently, in the late 1990s and early 2000s, SOEs shed approximately 40 million workers. SOEs accounted for over two-thirds of China's exports as late as 1995, but by 2016 accounted for only 10% of exports as the domestic private sector took off.[18]

III. The effectiveness of sector-specific industrial policy

The factors described above drove China's rise as a global manufacturing powerhouse deeply integrated into global supply chains. China went from autarky to the world's biggest exporter (2009), with a trade share of GDP over 65% in 2006, compared to 21% for the US.

But beginning in the mid-2000s and especially following the global financial crisis, Chinese policymakers became concerned that China was stuck in low-value-added production and subsequently devoted more explicit attention towards techno-industrial policy, including intentional positioning of China in GVCs with a focus on "indigenous innovation." Increasingly over the past decade, China's policymakers rolled out centrally-formulated industrial policies for industrial upgrading and reducing supply chain vulnerability. These policies included trade/investment restrictions, new tax policies and subsidies, direct investment through state-owned guidance funds, regulations and pricing support, ownership policies, and overseas acquisitions. And industrial policy formulation itself became increasingly standardized and rigorous.[19]

Yet mismatched local government and firm incentives and capabilities have often undermined implementation of these central industrial policies and investment plans. Although China's sector-specific industrial policies are often highlighted as effectively driving China's new technological innovation and GVC dominance, the actual efficacy of China's central industrial policy toolkit is determined by the incentives and capabilities of the local government officials who implement industrial policy. China has a five-tier administrative system—center, province, prefecture/city, county, and township—and is highly decentralized within this structure, with 85% of fiscal expenditure at the sub-national level. In a vast country with country-sized provinces, delegation to local officials is key, and in China local officials have high degrees of autonomy given that local enforcement agencies often lack autonomy from local leadership and information asymmetries between central and local governments make monitoring and evaluation of local enforcement practices challenging.

[17] Brandt, L., J.V. Biesebroeck, L.H. Wang, and Y.F. Zhang. 2017. "WTO Accession and Performance of Chinese Manufacturing Firms." *American Economic Review* 107(9): 2784-2820.
[18] Based on data from China Statistical Yearbooks, National Bureau of Statistics, various years.
[19] Chen, L. and B. Naughton. 2016. "An Institutionalized Policy-making Mechanism: China's Return to Techno-industrial Policy." *Research Policy* 45(10): 2138-2152.

Local officials thus implement industrial policies with considerable discretion, both as a consequence of *de jure* delegation of policymaking authority and *de facto* policy implementation autonomy. Locally-adapted industrial policies proliferate sub-nationally and define China's formal industrial policy landscape. With over 300 prefecture/city-level units and nearly 3000 county-level units, this is a very varied landscape. Additionally, Chinese policies are often based on broad central guidance with wide scope for local implementation, and industrial policy is no exception.[20] Most of the key elements of Chinese industrial policy are thus locally determined and implemented, including preferential credit, below-value land sale, government guidance fund investments, direct subsidies, and, to some extent, tax breaks.[21] The "central" share of investment itself declined from 13.3% in 2003 to 4.7% in 2015.[22]

Given local government discretion in industrial policy implementation, it is essential to understand local officials' incentives. China's local officials are upwardly accountable to superiors at the next administrative level who determine their career prospects—county officials are accountable to city officials, city officials to provincial officials, and provincial officials to central officials. This hierarchical principal-agent system relies on designing rules that align local incentives with central goals and priorities.

Two characteristics of this hierarchical cadre management system help to explain industrial policy implementation: simple targets (economic growth and social stability) and short tenures (generally less than three years). China's central priority has been economic development, proxied by GDP growth, and "tournament promotion competition" in which only local cadres who generate the best economic outcomes receive promotions, has successfully incentivized local leaders to promote growth.[23] This competition played a role in incentivizing local officials to compete for foreign and domestic investment as well as "local developmental state" type policies in which the government seeks to help firms grow.[24] Yet local officials must achieve growth while avoiding

[20] As documented by the "fragmented authoritarianism" literature, China's local authorities have a long history of "implementation bias" in a wide variety of policy areas. See: Lieberthal, K. G., and D.M. Lampton (Eds.). 1992. *Bureaucracy, politics, and decision making in post-Mao China*. Berkeley: University of California Press.

[21] A recent report estimates these industrial policy categories as a share of China's GDP: direct taxes/subsidies (0.8% of GDP), below market credit (0.5% of GDP), below-market land sales (0.3%), and state investment funds (0.1%). See: DiPippo, G., I. Mazzocco, and S. Kennedy. 2022. *Red Ink: Estimating Chinese Industrial Policy Spending in Comparative Perspective*. Washington, DC: Center for Strategic and International Studies. Regarding the role of local governments, local governments control land sales and help direct local credit. They are also responsible for over 80% of government guidance funds. See: Naughton, B. 2021. *The Rise of China's Industrial Policy, 1978 to 2020*. Universidad Nacional Autónoma de México.

[22] "Central" investment refers to investment by enterprises and administrative units subordinate to the CCP Central Committee, the National People's Congress, and the State Council. See: Holz, C.A. 2019. "Industrial Policies and the Changing Patterns of Investment in the Chinese Economy." *The China Journal* 81: 23-57.

[23] See: Li, H., and L. Zhou. 2005. "Political turnover and economic performance: the incentive role of personnel control in China." *Journal of Public Economics* 89: 1743–1762.

[24] 16 percent of private firms received government help securing loans, and 35 percent receive government help getting information. Cull, R., L. C. Xu, X. Yang, L. Zhou, and T. Zhu. 2017. "Market facilitation by local government and firm efficiency: Evidence from China." *Journal of Corporate Finance* 42: 460–480. See also: Bai, C.E., C.T. Hsieh, and Z.M. Song. 2020. "Special deals with Chinese characteristics." *NBER Macroeconomics Annual* 34: 341–379; Oi, J. C. 1992. "Fiscal reform and the economic foundations of local state corporatism in China." *World Politics* 45: 99–126.

social instability,[25] and they must achieve rapid short-term growth given short tenures: local leaders are generally appointed from other localities and only serve 2-3 year terms, on average.

These short-term growth incentives can result in suboptimal behavior from the central government's perspective. For instance, local officials may be incentivized to increase local debt to unsustainable levels, or to keep uncompetitive firms open in order to reduce unemployment, preventing creative destruction. This local government sub-optimal support may help to explain the rise of 'zombie firms,' those with consecutive years of losses and access to subsidized credit, which account for 15% of industrial firm credit.[26] Local officials may also choose to ignore or only partially implement central regulations that could undermine short-term growth, including environmental regulations or industrial capacity reductions. Incentives for close state-firm relations also lead to collusive state-business relations and corruption that result in misallocation of government support, with politically connected local firms receiving preferential treatment[27] and firms without connections resorting to bribery to receive these favors.[28]

The cadre management system may therefore face challenges in incentivizing local leaders to pursue industrial policy that aims to boost sustainable long-term productivity growth, and available evidence suggests poor local implementation of central industrial policies. Looking at six major central industrial policies, including the 12th and 13th Five-Year-Plans and Made in China 2025, Carsten Holz finds that these policies do not determine actual investment patterns in China: private entrepreneurship determines sectoral investment patterns rather than industrial policy, and the central government has very limited direct impact on investment.[29] Instead of targeting high-potential firms in targeted sectors, local officials may target politically connected firm or those whose closure would negatively affect short-term growth and thus promotion prospects. My own work with Xun Yan and Qiong Zhang uses a tax and subsidy database to show that financial support for firms has targeted low productivity, old, large, and loss-making firms rather than new, productive firms in emerging industries.[30] We show that these patterns are driven by local officials' career incentives—providing more subsidies and tax breaks to large loss-making firms helps city-level officials win promotions.

Poor implementation suggests that although government support may help individual firms, support as implemented also generates economy-wide market distortions that prevent creative

[25] In China, 'stability overrides everything' (稳定压倒一切) and preventing local social instability is therefore a 'veto target' (一票否决) that when triggered eliminates the possibility for promotion. See Edin, M. 2003. "State capacity and local agent control in China: CCP cadre management from a township perspective." *The China Quarterly* 173: 35–52.

[26] Lam, W.R., A. Schipke, Y. Tan, and Z. Tan. 2017. "Resolving China's zombies: Tackling debt and raising productivity." IMF Working Paper No. 17/266. Washington, DC: International Monetary Fund.

[27] Chen, T., and J.K. Kung. 2019. "Busting the 'princelings': The campaign against corruption in China's primary land market." *Quarterly Journal of Economics* 134: 185–226; Liu, N., L. Wang, and M. Zhang. 2013. "Corporate ownership, political connections and M&A: Empirical evidence from China." *Asian Economic Papers* 12(3): 41–57.

[28] Fang, H., Z. Li, N. Xu, and H. Yan. 2018. "In the shadows of the government: Relationship building during political turnovers." NBER Working Paper 25300. Cambridge, MA: National Bureau of Economic Research.

[29] Holz, "Industrial Policies"

[30] Bulman, D.J., X. Yan, and Q. Zhang. 2022. "Picking Losers: How Career Incentives Undermine Industrial Policy in Chinese Cities." *The Journal of Development Studies*.

destruction.[31] And indeed, our paper shows that these subsidies and tax breaks have large distorting effects: the more government financial support in a given city and sector, the lower productivity growth is and the fewer firms enter. In this sense, the rapid rise in local subsides in China may help to explain China's declining levels of firm entry and productivity.[32]

These findings help provide an understanding for the vast firm-level misallocation of innovation funding in China. Private and foreign firms are considerably more innovative than SOEs: for every 10 million RMB of firm-level R&D investment, private firms generate 6.5 patents, foreign firms generate 7.6 patents, and SOEs generate only 2.2 patents. And smaller firms are considerably more innovative than larger firms, regardless of ownership: the smallest quintile private sector firms produce 3.2 times as many patents per R&D expenditure than the largest quintile private sector firms; for SOEs, this ratio rises to 6.3 times.[33] Yet R&D subsidies and tax breaks predominantly target large firms, and particularly large SOEs,[34] likely for the same career-related reasons and political connection reasons discussed above.[35] This helps to explain massive misallocation of R&D spending,[36] along with firm incentives to take advantage of R&D tax breaks by artificially inflating actual R&D spending.[37]

Change under Xi?

Xi Jinping has attempted to change China's governance and cadre management over the past ten years, with explicit attention towards a move away from "GDP worship" as well as an anti-corruption campaign and environmental inspections to limit problems stemming from excessive local discretion. Institutional reforms have attempted to recentralize central authority by:

[31] Aghion, P., and P. Howitt. 1992. "A model of growth through creative destruction." *Econometrica* 60: 323–351.
[32] Brandt, L., J. Litwack, E. Mileva, L. Wang, Y. Zhang, and L. Zhao. 2020. "China's productivity slowdown and future growth potential." World Bank Policy Research Working Paper 9298. Washington, DC: World Bank Group; Tan, Y., Y. Huang, and W.T. Woo. 2016. "Zombie firms and the crowding-out of private investment in China." *Asian Economic Papers* 15(3): 32–55.
[33] Based on data in Wei, S.J., Z. Xie, and X.B. Zhang. 2017. "From 'Made in China' to 'Innovated in China': Necessity, Prospect, and Challenges." *Journal of Economic Perspectives* 31(1): 49-70.
[34] SOEs account for 10.9% of R&D expenditure but 21.5% of government R&D funding support. See: Liu, X.L., S..S. Serger, U. Tagscherer, and A.Y. Chang. 2017. "Beyond catch-up—can a new innovation policy help China overcome the middle income trap?" *Science and Public Policy* 44(5): 656–669.
[35] Cheng, Fan, Hoshi, and Hu find that China's innovation subsidies are targeted at politically connected firms, helping to explain why firms that receive these subsidies are not more productive or more profitable. See: Cheng, H., H.B. Fan, T. Hoshi, and D.Z. Hu. 2019. "Do Innovation Subsidies Make Chinese Firms More Innovative? Evidence from the China Employer Employee Survey." NBER Working Paper 25432. Cambridge, MA: National Bureau of Economic Research.
[36] Konig, Song, Storesletten, and Zilibotti find that less productive firms have too much R&D spending, while more productive firms do not have enough, and that if China allocated R&D spending efficiency to that of Taiwan, aggregate manufacturing productivity from 2001-2007 could have grown by up to one-half. See: König, K.D., K. Storesletten, Z. Song, and F. Zilibotti. 2020. "From Imitation to Innovation: Where Is All That Chinese R&D Going?" Cowles Foundation Discussion Papers 1.
[37] Chen, Liu. Suarez Serrato and Xu find that a large share of firms respond to R&D tax incentives by simply relabeling non-R&D expenditures as R&D expenses. See: Chen, Z., Z.K. Liu, J.C. Suárez Serrato, and D.Y. Xu. 2021. "Notching R&D Investment with Corporate Income Tax Cuts in China." *American Economic Review* 111(7): 2065-2100.

strengthening vertical supervision of subnational bureaucracies;[38] revising cadre appointment guidelines to put more emphasis on ideology and political loyalty;[39] emphasizing obedience to central party decisions;[40] and establishing a new National Supervisory Commission to investigate and monitor subnational officials' behavior.[41]

But while Xi has recentralized power, the effects on local governance and implementation are unclear. Indeed, there is emerging evidence that at the local level promotion processes are less transparent with fewer objective criteria and more influence of top party leaders, leading to more scope for clientelism.[42] Under Xi, term lengths for local leaders have shrunk even further, and there are also fewer local cadres with stronger intrinsic motivations and ties to their locality. In work with Kyle Jaros, I find that despite the appointment of many more "central" cadres to provincial leadership positions, local implementation of central policies remains problematic.[43] And although there is some evidence that the anti-corruption campaign has made local officials somewhat more responsive to central policy,[44] local officials in charge of allocating resources have increasingly shirked responsibility, leading to less local dynamism and slower economic growth.[45]

In sum, then, China has increasingly relied on sector-specific industrial policies, but these policies are predominantly implemented by local governments whose incentives are not aligned with the long-term growth objectives pursued by the center. These officials instead seek to maximize short term growth and minimize creative destruction and attendant unemployment, and Xi's institutional reforms have not altered this calculus. Consequently, industrial policy as implemented is much less effective than U.S. policymakers often assume. This is not to say that all of China's industrial policies fail, but rather that their efficacy and explanatory power regarding broader industrial and exporting trends in China is overstated.[46]

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[38] See, for instance, the discussion of centralization in the environmental policy realm in Kostka, G., and J. Nahm. 2017. "Central–Local Relations: Recentralization and Environmental Governance in China." *The China Quarterly* 231: 567-582.

[39] Xinhua. 2019. 中共中央印发《党政领导干部选拔任用工作条例》. March 17. Accessed June 2, 2022: http://www.xinhuanet.com/politics/2019-03/17/c_1124245012.htm.

[40] Li, L. 2019. "Politics of Anticorruption in China: Paradigm Change of the Party's Disciplinary Regime 2012–2017." *Journal of Contemporary China* 28(115): pp. 47-63.

[41] Ibid.

[42] Doyon, J. 2018. "Clientelism by Design: Personnel Politics under Xi Jinping." *Journal of Current Chinese Affairs* 47(3): 87-110.

[43] Bulman, D.J., and K.A. Jaros. 2021. "Localism in Retreat? Central-Provincial Relations in the Xi Jinping Era." *Journal of Contemporary China* 30(131): 697-716,

[44] For instance, Fang, Lerner, Wu, and Zhang find that R&D subsidies become better targeted after removal of government innovation officials following anti-corruption investigations. See: Fang, L.H., J. Lerner, C.P. Wu, and Q. Zhang. 2018. "Corruption, Government Subsidies, and Innovation: Evidence from China." NBER Working Paper No. w25098.

[45] For instance, a 2015 survey by the China Executive Leadership Academy in Shanghai found that 62% of leading cadres attributed the problem of "official neglect of duties" (为官不为) to fear of being held liable for problems, while 42% blamed strict discipline with unclear "red lines." For the anti-corruption campaign's negative growth effect, see: Qu, G.J., K. Sylwester, and F. Wang. 2018. "Anticorruption and growth: Evidence from China." *European Journal of Political Economy* 55: 373-390.

[46] For instance, the relocation of component manufacturing to China itself—imports of components as a share of assembled products fell from 90% in 2005 to 60% in 2017—is more of a consequence of domestic strength in

IV. Sectoral variation

The previous sections highlight that (1) in general terms, China's supply chain dominance has arisen from natural comparative advantages; (2) China's policymakers have nevertheless employed targeted industrial policies to achieve dominance or reduce vulnerability in specific sectors; and (3) these targeted measures have only been partially effective given implementation challenges. Consequently, industrial sectors exhibit wide variation in terms of both central policy support and China's level of global supply chain centrality/dominance. These two dimensions combine to create a 2x2 matrix, seen in Table 1 below.

Table 1. China's central industrial policy support and supply chain dominance

		Central industrial policy support	
		Low	*High*
Supply chain dominance	*High*	Pattern 1: Comparative advantage *Examples: ITC, rare earth elements, textiles*	Pattern 2: Emerging low/medium-tech industries *Examples: solar cells, high-capacity batteries*
	Low	Not applicable	Pattern 3: Incumbent high-tech industries *Examples: semiconductors, passenger aircraft*

The following three subsections look at the three key patterns identified in Table 1, taking as examples three of the four sectors highlighted in the Biden Administration's Executive Order 14017 on building resilient supply chains: rare earth elements (REE) as an example of supply chain dominance *without* central policy support; high-capacity batteries as an example of supply chain dominance *with* central policy support; and semiconductors as an example of supply chain weakness *despite* central policy support. I ignore sectors with neither policy support nor market dominance.

manufacturing than targeted industrial policy. Similarly, the decline in FIE share of domestic manufacturing has more to do with domestic private sector growth than policies that harm foreign enterprise or prevent FDI.

Pattern 1. Supply chain dominance without central policy support (example: rare earth elements)

As highlighted above, China's trade liberalization and broad market liberalization along with natural comparative advantages including a well-educated and low-cost labor force were the most important factors behind China's emergence as the world's largest manufacturer and a central hub in global value chains. Consequently, China has come to dominate many manufacturing sectors without targeted industrial policies.

One perhaps surprising example of a sector that China has come to dominate without effective central support is rare earth elements (REE) mining and production. E.O. 14017 directed the government to focus on REE given their centrality to modern manufacturing and the fact that China controlled 55% of REE mining capacity in 2020 and 85% of refining.[47] Yet although the E.O. 14017 review concludes that China's non-market activities "contributed to the erosion and then elimination of U.S. production in the global market," the cited policies—a 2003 acquisition by a Chinese-invested conglomerate of a loss-making NdFeB magnet producer and VAT rebates for rare earth exports beginning in 1985—had little to do with China's actual dominance.

Instead, China's REE dominance should be seen as a consequence of local incentives for overproduction with limited environmental regulation and relatively high REE reserves;[48] REE dominance emerged *despite* central policy, which has sought to reduce local overcapacity and improve environmental regulation implementation. And while China was building capacity in the 1980s and 1990s, advanced economies were shutting down polluting mines.[49]

REE mining and production took off in the 1980s and 1990s based on proliferation of dispersed local mines and illegal production that took advantage of rising profits. These firms and local governments did not internalize environmental costs, with deleterious results.[50] As early as the 1990s, central policy makers attempted to shut down illegal mines and limit environmental damage, but failed to gain control.[51] Failure led to a system of export quotas in 1999, followed by production quotas and new taxes, all attempting to rein in local production, but these central measures had the unintended consequence of incentivizing *more* illegal production, as only illegal producers could avoid taxes and the quota system.[52] Throughout this period, local governments cooperated with illegal REE mines to support local employment and growth.[53] Consequently,

[47] The White House. 2021. *Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth.* 100-Day Reviews under Executive Order 14017. Accessed June 2, 2022: https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf.

[48] According to the U.S. Geological Survey, China's REE reserves are approximately 44 million tons, accounting for 37% of world reserves.

[49] Shen, Y., R. Moomy, and R.G. Eggert. 2020. "China's public policies toward rare earths, 1975–2018." *Mineral Economics* 33: 127–151.

[50] Yang, X.J., A. Lin, X.L. Li, Y. Wu, W. Zhou, and Z. Chen. 2013. "China's ion-adsorption rare earth resources, mining consequences and preservation." *Environmental Development* 8:131–136.

[51] Shen, Moomy, and Eggert, "China's public policies toward rare earths"

[52] Ibid.

[53] Packey, D.J., and D. Kingsnorth. 2016. "The impact of unregulated ionic clay rare earth mining in China." *Resources Policy* 48:112–116.

illegal REE mining has been rampant, with estimates ranging from 30% of all production during 2005-2012 to 50% after 2017, implying a continued failure of central efforts to halt illegal local production, even in recent years. [54]

This is not to say that China has not since attempted to re-assert central control to make REE a more centrally-planned industry and potential coercive foreign policy tool. In 2010, China's use of quotas led to sharp export reductions at a time of political conflict with Japan, and China planning agency suggested China could use REE quotas for leverage in the U.S.-China trade war.[55] In 2016, China consolidated rare earth production into six large SOE groups in an effort to make production quotas more binding,[56] and in late 2021 China announced the creation of a new REE SOE (China Rare Earth Group).[57] But these measures have had limited—and often unintended—effects. For instance, when quotas were limited in 2010, domestic REE prices shot up 10-fold, leading to both more imports in the short-term and more incentives for illegal production in the medium-term. [58] And central consolidation and industrial policies over the past decade have coincided with China having *less* control over global REE production: China's share of world REE mine production fell from 98% in 2010 to 58% in 2020 as other countries increased production.[59]

Pattern 2. Supply chain dominance with central policy support (example: high-capacity batteries)

Recent central policy failure in the REE sector does not imply complete impotence of central industrial policy, but suggests that such industrial policy may require certain conditions to succeed. When central goals (e.g., limiting environmental damage and curbing illegal production) contradict local incentives for rapid short-term growth, these central policies are likely to fail. In the case of emerging industries with no dominant incumbent domestic or foreign players, broad demand-side policies and local protectionism have proven to be more aligned with local incentives, making them more effective.

China's industrial policies have sought to identify emerging industries that will become important, with attention to "alternative routes" and "overtaking on a curve" (弯道超车), and China has had particular success in fields with a combination of low/medium technological requirements, surging demand, and extensive labor needs. Solar cell production constituted one early case of successful

[54] See discussion in Shen, Moomy, and Eggert, "China's public policies toward rare earths."
[55] Zheng, S. 2019. "China will not rule out using rare earth exports as leverage in trade war with US." *South China Morning Post*. 29 May. Accessed June 2, 2022: https://www.scmp.com/news/china/diplomacy/article/3012199/china-will-not-rule-out-using-rare-earth-exports-leverage.
[56] Consolidation had been proposed since 2002, but local governments resisted handing control of a profitable industry to SOEs outside of their province. See Yang, D. 2015. *中国稀土产业发展与政策研究 [Research on China's rare earth industry development and policies]*. Beijing: China Social Sciences Publishing House.
[57] Zhai, K. 2021. "China Set to Create New State-Owned Rare-Earths Giant." *The Wall Street Journal*. 3 December. Accessed June 2, 2022: https://www.wsj.com/articles/china-set-to-create-new-state-owned-rare-earths-giant-11638545586.
[58] Yu, S., and T. Mitchell. 2020. "State interference threatens China's control of rare earth production." *Financial Times*. 28 October. Accessed June 2, 2022: https://www.ft.com/content/b13a3c4e-e80b-4a5c-aa6f-0c6cc87df638?segmentId=114a04fe-353d-37db-f705-204c9a0a157b.
[59] USGS. Rare Earths Statistics and Information. Mineral Commodity Summaries, various years.

policy in China. Today, China produces 80% of global solar cell output, and the U.S. has almost no domestic capacity.[60]

Perhaps the best example of successful policy is high-capacity batteries, predominantly manufactured for use in electric vehicles (EV).[61] China played catch-up for years attempting to generate competitiveness in internal combustion engine (ICE) automobiles, with little success. But China became the largest market for EVs as a consequence of government policy, and as a direct consequence of this policy-generated EV demand, along with protectionism and infrastructure investment, China now commands 75% of advanced cell fabrication capacity for high-capacity batteries globally and is home to two of the top four battery makers in the world (CATL and BYD).[62] In terms of protectionism, China's EV subsidy scheme has supported domestic battery producers, and China has required technology transfers for EV companies looking to invest in China. In terms of infrastructure, China pushed forward to develop charging stations throughout the country.[63]

But the most effective policies for creating a domestic battery market were demand-side policies supporting EVs, including consumer subsidies, mandated government purchases, and various forms of local government support for EV purchases, including lower license plate fees and free parking. The subsidy policy itself, with average local and central subsidies of approximately $10,000 per vehicle,[64] were extremely successful at incentivizing EV purchases: after their rollout nationwide in 2013, EV sales growth in 2014 and 2015 was over 300% annually, and China has been the largest market for plug-only and plug-in hybrid EVs since 2015.[65] And as a result of local procurement policies, China now has 421,000 electrically-powered buses, compared to only 300 in the U.S.

Despite China's success creating EV demand that spurred high-capacity battery production, China's industrial policy story should not be seen as an unmitigated success, nor is future success in the sector guaranteed. With relatively weak ICE incumbents, local governments in China were very supportive of EVs and high-capacity batteries. But this support has resulted in considerable waste and cost-ineffective investment and subsidies. Between 2009 and 2017, China's central and local governments spent approximately $50 billion on consumer subsidies and sales tax

[60] Though even in solar, subsidies did not play as important a role as China's large labor force and local government industrial parks. See: Ball, J., D. Reicher, X.J. Sun, and C. Pollock. 2017. *The New Solar System: China's Evolving Solar Industry and Its Implications for Competitive Solar Power in the United States and the World*. Stanford. Accesed June 2, 2022:: https://law.stanford.edu/wp-content/uploads/2017/03/2017-03-20-Stanford-China-Report.pdf.
[61] EVs account for 80-85% of high-capacity batter use. See White House, *Building Resilient Supply Chains*.
[62] The White House, *Building Resilient Supply Chains*
[63] See: State Council. 2018. "提升新能源汽车充电保障能力行动计划 [Action Plan for Enhancing the Guaranteed Charging Capacity for Electric Vehicles]." Notice No. 1698.
[64] Electric buses could receive subsidies of up to $87,000. See: Mazzocco, I. 2020. "Electrifying: How China Built an EV Industry in a Decade." *MacroPolo*. July 8. Accessed June 2, 2022: https://macropolo.org/analysis/china-electric-vehicle-ev-industry/.
[65] Du, J.Y., and D.H. Ouyang. 2017. "Progress of Chinese Electric Vehicles Industrialization in 2015: A Review." *Applied Energy* 188: 529–46. Teece, D.J. 2019. "China and the Reshaping of the Auto Industry: A Dynamic Capabilities Perspective." *Management and Organization Review* 15(1): 177–199.

exemptions,[66] over one-quarter of total EV sales. With large subsidies, there has unsurprisingly been considerable evidence of corruption and fraud.[67] And access to easy money led the number of registered EV firms to explode to over 400 by 2018, even though only 15% appear to actually manufacture any cars, with many of these cars of low quality.[68] And China's all-out approach based on artificially-manufactured demand has concentrated production in relatively low-tech batteries that may soon be superseded by foreign firms, with Chinese average battery capacity growth lagging behind the global average over the last decade.[69]

Finally, despite recent ambitions to remove subsidies and move towards a more market-based approach to incentivizing EV sales and production, announced as early as 2016,[70] it is unclear if EV demand can survive subsidy removal. Indeed, after sales plummeted following the removal of most subsidies in 2019, the government quickly re-introduced the subsidies.[71] Europe in the past year emerged as the world's largest EV market based on a more market-based regulatory approach, without requiring China's scale of government subsidization, putting the future of China's EV market and high-capacity battery dominance in question.

Pattern 3: Central industrial policy support without supply chain dominance (example: semiconductors)

Although China has had industrial policy success in several emerging industries, in many other sectors Chinese industrial policy has been expansive and expensive with underwhelming results. Generally, these sectors appear to have high capital and technological requirements as well as large existing global markets/demand and foreign incumbents. In these sectors, China's ability to pick winners has proved limited, leading to waste as subsidies and investments have been distorted while traveling through the prism of China's hierarchical system. Demand-side subsidies, so important in the case of emerging industries, have been ineffective given preexisting high levels of global demand.

Semiconductors may be the prime example in which policy has not produced hoped-for results. High-end chips have been consistently targeted by China's central policy makers for financial support. In the late 1990s and early 2000s, China utilized bureaucratic processes to attempt to

[66] Kennedy, S. 2018. *China's Risky Drive into New-Energy Vehicles*. Washington, DC: Center for Strategic and International Studies.
[67] Ai, L.M., and C. Feng. 2017. "China Pulls Plug on Electric Vehicle Fraud." *Caixin Global*. 6 February. Accessed June 2, 2022: https://www.caixinglobal.com/2017-02-06/china-pulls-plug-on-electric-vehicle-fraud-101050629.html.
[68] Mazzocco, "Electrifying."
[69] ICCT. 2021. "Race to Electrify Light-Duty Vehicles in China, the United States and Europe: A Comparison of Key EV Market Development Indicators," The International Council on Clean Transportation. February 4. Accessed June 2, 2022: https://theicct.org/wp-content/uploads/2021/06/china-green-future-ev-fs-feb2021-01.pdf.
[70] See discussion in Mazzocco, "Electrifying."
[71] See: Ministry of Finance. 2020. 关于《财政部 工业和信息化部 科技部 发展改革委关于调整完善新能源汽车补贴政策的通知（财建〔2020〕86 号）》的解读. Accessed June 2, 2022: http://www.gov.cn/zhengce/2020-04/23/content_5505506.htm.

create large semiconductor firms, with little to show.[72] In the mid-2000s, central planners attempted to use more sophisticated industrial policy support to encourage both state and private sector chip development through new incentives.[73] But the Hanxin 1 scandal and SMIC's intellectual property theft case demonstrated how far behind China remained, leading to massive amounts of new funding beginning with the 12th Five Year Plan.[74] The National IC Industry Development Fund created in 2014, with a second phase in 2018, led to approximately 500 billion RMB in funding, mostly for fabrication.[75] And local governments have provided more than 300 billion RMB in guidance funds.[76] Yet China's semiconductor sector continues to lag, with most high-end design still controlled by foreign firms and most Chinese companies only supplying mid-to-low-end design and fabrication.[77] The Trump Administration's decision to put ZTE on the entity list in April 2018 was China's "Sputnik moment," indicating how far behind China remained and how dependent its economy remained on foreign technology and production.[78]

China's failure to break through in semiconductors is a result of failed industrial policy: assessing firm quality and picking winners is difficult given information asymmetries in highly technical fields, and local governments may be especially vulnerable to incentives to get money out the door fast. Most semiconductor policy funding was intended to target top firms in each category of production,[79] but included very little investment in long-term R&D. Guidance funds sought to follow market rules for equity investments, but the incentives facing bureaucrats and officials in charge of allocation remain short-term, leading to investments in lagging (known) technologies.[80]

Targeting firms with local governments controlling the levers can lead to massive failures. Local governments have provided at least 300 billion RMB to support local semiconductor industries, but in just the past three years at least 10 different multibillion RMB chip projects failed, prompting

[72] Jiang Zemin argued that China needed to "develop China's semiconductor industry at all costs" after vising a Samsung factory in Korea, leading to Project 908 and Project 909. See: He, A. 2021. "China's Techno-Industrial Development: A Case Study of the Semiconductor Industry." CIGI Papers No. 252. Accessed June 2, 2022:: https://www.cigionline.org/sites/default/files/documents/no.252%20web.pdf.
[73] Ibid.
[74] For the Hanxin 1 scandal, see: Lemon, S. 2006. "An elaborate chip fraud unravels in China." *Computerworld*. 15 May. Accessed June 2, 2022: https://www.computerworld.com/article/2549655/an-elaborate-chip-fraud-unravels-in-china.html. For the SMIC lawsuit, see: Keating, G. 2009. "California jury finds SMIC stole trade secrets." *Reuters*. 3 May. Accessed June 2, 2022: https://www.reuters.com/article/us-smic-lawsuit/california-jury-finds-smic-stole-trade-secrets-idUSTRE5A26CA20091103.
[75] Xinhua. 2014. "国家集成电路产业投资基金正式成立 [National IC Industry Investment Fund formally established]. *Xinhua*. October 14. Accessed June 2, 2022: www.gov.cn/xinwen/2014-10/14/content_2764849.htm; Li, N., and S.S. Lai. 2019. "国家大基金二期落地 两千亿投向何方 [The second phase of the National IC Fund has arrived; where will the 200 billion RMB fund invest]." *Yicai*. October 28. Accessed June 2, 2022: www.yicai.com/news/100380063.html.
[76] Zhang, J. 2021. "China's semiconductors: How Wuhan's challenger to Chinese chip champion SMIC turned from dream to nightmare." *South China Morning Post*. 20 March. Accessed June 2, 2022: https://www.scmp.com/tech/tech-trends/article/3126124/chinas-semiconductors-how-wuhans-challenger-chinese-chip-champion.
[77] He, "China's Techno-Industrial Development."
[78] Ibid.
[79] Ibid.
[80] Ibid.

China's central planners to promise to clean up the "chaotic" industry.[81] The HSMC scandal was perhaps the most high-profile, after an entrepreneur with only an elementary school education convinced the Dongxihu district government to put up 200 million RMB and the Wuhan city government to commit over 15 billion RMB to build a semiconductor production company that never got off the ground.[82] Other examples of local governments ploughing money into failed semiconductor projects include Nanjing Dekema and Shaanxi Kuntong Semiconductor Technology.[83] The underlying problem is clear to industry insiders. As one analyst in Shanghai notes: "Some local governments that are eager to launch hi-tech projects lack relevant experience and clear understanding of project risks. They simply use generous subsidies and large amounts of capital to attract projects."[84]

V. Conclusions and policy recommendations

This testimony has argued that China's supply chain dominance has arisen largely from natural comparative advantages. China's central policymakers increasingly employ targeted industrial policies to achieve dominance or reduce vulnerability in specific sectors, but these policies have only been partially effective given distorted implementation by local governments.

The broadest recommendation for U.S. policymakers that arises from these conclusions: *do not overestimate the threat that China's GVC dominance poses*. There may be very good reasons to engage in domestic industrial policy, impose taxes on outsourcing, or directly pay firms to "reshore" and bring manufacturing production back to the United States. These good reasons could include concerns about American job creation and climate change. But the threat from China should not be a key motivation. There are four broad reasons why U.S. industrial policy with the explicit goal of reducing reliance on China may be misguided, in increasing order of importance:

First, China's entry into GVCs has been and continues to benefit the US. China's entry into GVCs has led to considerable welfare gains from price decreases, despite documented job losses from import competition.[85] Additionally, China's subsidization can serve as a global public good: the cost of solar energy fell by over 80% over the past decade, becoming cheaper than either coal or natural gas in 2018, as has the cost per kilowatt-hour of lithium-ion batteries, enabling growth of the EV market. Neither of these price reductions would have been possible without China's non-market interventions.

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[81] Lee, A. 2020. "China to curb 'chaos' in semiconductor industry and hold bosses accountable for risky, loss-making projects." *South China Morning Post*. 20 October. Accessed June 2, 2022: https://www.scmp.com/economy/china-economy/article/3106307/china-curb-chaos-semiconductor-industry-and-hold-bosses?module=inline&pgtype=article.

[82] Zhang. "China's semiconductors."

[83] Cortese, A.J. 2021. "Semiconductor squander: China's chip drive leaves unqualified projects languishing." *KrAsia Insights*. 11 June. Accessed June 2, 2022: https://kr-asia.com/semiconductor-squander-chinas-chip-drive-leaves-unqualified-projects-languishing.

[84] Zhang, "China's semiconductors."

[85] China's WTO entry reduced the U.S. manufacturing price index by 7.6 percent between 2000 and 2006. See: Amiti, M., M. Dai, R.C. Feenstra, and J. Romalis. 2017. "How Did China's WTO Entry Affect U.S. Prices?" Federal Reserve Bank of New York Staff Report No. 817.

Second, any effective measures to convince companies to leave China would be very expensive and could lead to harmful retaliation given the importance of the Chinese market to American industry. Policies intended to dis-incentivize outsourcing to China are difficult, long-term, and costly, as indicated by the limited effectiveness of the trade war tariffs. Part of this is because GVCs break down effectiveness of bilateral measures as well as links between relative prices and trade performance. More importantly, the largest U.S. supply chain vulnerability vis-à-vis China is getting cut off from exporting to and selling in China. This is clear in Biden supply chain report in references to semiconductors: "Heavy reliance on sales to China provides the Chinese Government with economic leverage and the potential to retaliate against the United States."[86]

Third, China's economy is more vulnerable to U.S. economic coercion than vice versa, making China's aggressive use of coercive supply chain disruptions aimed at the U.S. unlikely. Most of China's economic coercion—which China has become increasingly quick to use for political purposes—is limited in scope and impact. China's use of coercive economic tools is special for several reasons, including willingness to use trade as a short-term coercive measure;[87] the role of SOEs, which serve as a the channel for trade shocks following "political incidents" with China's trade partners;[88] the role of state media and propaganda to drive consumer boycotts;[89] and, most importantly, China's overall asymmetric trade importance to large set of countries.[90] But China's use of trade as a political tool is generally ineffective, and China has been loath to implement these tactics when they can harm China itself. In the case of the U.S.-China bilateral economic relationship, China remains considerably more asymmetrically dependent on the U.S. than vice versa, as indicated by China's financial vulnerabilities (i.e., potential for exclusion from Swift) and dependence on U.S. technology, as seen in the recent ZTE and Huawei cases.

Fourth, and most importantly, many companies are *already* leaving China as China's comparative advantage shifts and supply chain risks emerge; policy support would be a waste of taxpayer money. There are many reasons that China's comparative advantage is eroding and shifting, most importantly rising costs given a shrinking labor force as well as greater environmental and labor taxation. Additionally, the environment for foreign firms has deteriorated in Xi's state-led economy. According to AmCham China, approximately one in five U.S. firms based in China have already moved or are considering moving capacity outside of China; tariffs played a role, but

[86] See White House, *Building Resilient Supply Chains*. U.S. semiconductor chip makers rely heavily on China for sales given that China is the largest market for semiconductors: Qualcomm generates two-thirds of its revenue in China and Micron generates 57% of its revenue in China.

[87] For example, countries that officially receive Dalai Lama visits experience reduced exports to China as a result. Fuchs, A., and N.-H. Klann. 2013. "Paying a visit: The Dalai Lama effect on international trade." *Journal of International Economics* 91(1): 164-177.

[88] Davis, C.L., A. Fuchs, and K. Johnson. 2019. "State Control and the Effects of Foreign Relations on Bilateral Trade." *Journal of Conflict Resolution* 63(2): 405-438.

[89] Vekasi, K., and J. Nam. 2019. "Boycotting Japan: Explaining Divergence in Chinese and South Korean Economic Backlash." *Journal of Asian Security and International Affairs* 6(3): 299-326.

[90] This asymmetric dependence can lead to political alignment. For instance, developing countries become more aligned with Chinese voting patterns at the UN as they become more dependent on trade with China. Flores-Macias, G.A., and S.E. Kreps. 2013. "The Foreign Policy Consequences of Trade: China's Commercial Relations with Africa and Latin America, 1992–2006." *The Journal of Politics* 75(2): 357-371.

not as big a role as rising labor costs and slowing Chinese growth.[91] Shifts out of China have been especially apparent in labor intensive industries. Most recently, city-wide lockdowns in China as part of a "zero-Covid" policy and supply chain disruptions stemming from Russia's invasion of Ukraine (both countries far less integrated in the global economy than China), have made firms further consider duplicating or relocating their China-based supply chains. As early as May 2020, as a result of the pandemic, a McKinsey survey of global supply chain and business leaders found that 93% already planned to increase supply chain resilience, and 44% planned to do so at cost of short-term savings.[92]

Although policymakers should not overestimate the supply chain threat from China, America remains vulnerable as a consequence of dependence on concentrated Chinese production. An optimal response should: (1) address key vulnerabilities at a minimal cost in the short term; (2) incentivize Chinese adherence to international trade norms in the medium-term; and (3) ensure U.S. innovative advantages in the long-term. The following three policy recommendations address these three areas in turn:

1. Identify vulnerable sectors and generate targeted policy responses. Key policy and business communities should develop lists of key inputs that have no domestic sourcing, as DOD has already done.[93] There is no reason to focus solely on China: any single sourced product is a potential risk. Where the U.S. depends on a single source for *critical* inputs, efforts should be made to spur domestic production. As a good example of a cost-effective strategy: given that only half of vital pharmaceutical products have any U.S. production, $60 million has been allocated from the Defense Production Act to onshore 50-100 critical drugs on the FDA's essential medicines list. As an alternative to generating domestic production, policymakers could also consider increasing stockpiles and designing emergency diversion plans.

2. Use trade pressure and trade carrots to shape Chinese policy: WTO reform and regional PTAs. In the medium term, the U.S. and the world would benefit from China's greater adherence to international trade norms. The 2018 U.S.-China trade war undermined the stated U.S. commitment to fair trade while also demonstrating that unilateral approaches to changing China's trade behavior are doomed to fail. Nevertheless, China has responded positively to regional and global trade carrots in the past given the importance of trade to the Chinese economy. The lack of a functioning dispute resolution body at the WTO does not make the U.S. stronger, and the U.S. should continue to work with like-minded countries to pursue WTO reform. Additionally, the U.S. should consider joining regional trade agreements, including the CPTPP. The recently mooted Indo-Pacific Economic Framework lacks public details, but does not appear to open the U.S. to greater imports, making it relatively ineffective and unattractive to potential trade partners.

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[91] American Chamber of Commerce in China. *Business Climate Survey 2020*. Summary accessed June 2, 2022: https://www.amchamchina.org/press/2020-business-climate-survey-released/.
[92] McKinsey Global Institute. 2020. *Risk, resilience, and rebalancing in global value chains.* August.
[93] Department of Defense. 2018. *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*. Report to President Donald J. Trump by the Interagency Task Force in Fulfillment of Executive Order 13806.

3. Maintain the U.S. innovation edge: stay open to Chinese students and scientists. Human capital is the most important advantage the U.S. has in high-tech, innovation-based sectors. Our universities are the best in the world, and attract the greatest minds from abroad, including from China. Consider artificial intelligence (AI): the U.S. employs 60% of the world's top-tier AI researchers, six times more than China, but two-thirds of these researchers immigrated to America after college (mostly to attend graduate school), and more than one-quarter are Chinese. Indeed, only one-third of Chinese top AI researchers stay in China, with 56% working in the U.S.[94] Recent policies that make it more difficult for Chinese nationals to study in the U.S.[95] and policies that make Chinese scientists feel unwelcome, including the Department of Justice's recently concluded China Initiative,[96] weaken American innovative capacity. The U.S. needs to stay open to Chinese students and do more to encourage these students to stay and work in the United States after graduation.

[94] Banerjee, I., and M. Sheehan. 2020. "America's Got AI Talent: US' Big Lead in AI Research Is Built on Importing Researchers." *MacroPolo*. 9 June. Accessed June 2, 2022: https://macropolo.org/americas-got-ai-talent-us-big-lead-in-ai-research-is-built-on-importing-researchers/?rp=m.

[95] The Trump administration shortened the duration of Chinese student visas for those studying aviation, robotics, and advanced manufacturing. See Mervis, J. 2018. "More restrictive U.S. policy on Chinese graduate student visas raises alarm." *Science*. 11 June. Accessed June 2, 2022: https://www.science.org/content/article/more-restrictive-us-policy-chinese-graduate-student-visas-raises-alarm. Additional policies restricting Chinese students from particular universities could reduce Chinese STEM graduate students in the U.S. by one-quarter. Hua, S. 2021. "Visa Restrictions on Chinese Students Endanger U.S. Innovation Edge, Universities Say." *The Wall Street Journal*. 2 November. Accessed June 2, 2022: https://www.wsj.com/articles/visa-restrictions-on-chinese-students-endanger-u-s-innovation-edge-universities-say-11635856001

[96] Gilbert, N., and M. Kozlov. 2022. "The controversial China Initiative is ending — researchers are relieved." *Nature*. 24 February. Accessed June 2, 2022: https://www.nature.com/articles/d41586-022-00555-z.