

CHINA'S INWARD TURN

The Pursuit of Economic Self-Reliance

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Johanna Chua is a Managing Director and Economist at Citi Research. Based in Hong Kong, Johanna oversees overall economic research across the Pan-Asia Region. Prior to 2009, she was the Chief Asia EM Trading Strategist and Asia Sovereign Fixed Income Analyst covering foreign exchange, local rates, and sovereign credit at Citi. She has a Ph.D. in Economics from Harvard University and is a summa cum laude graduate of the University of the Philippines.

+852-2501-2357 | johanna.chua@citi.com



Yuanliu Hu is a Senior Research Associate on the Asia Economics team, based in Hong Kong. Prior to joining Citi Research, Yuanliu spent five years as an Associate Economist at Institute of International Finance, covering Asia macro economy. Yuanliu holds a Master's degree in Applied Economics from the University of Michigan and a Bachelor's degree from Zhejiang University in Hangzhou.

+852-2501-2746 | yuanliu.hu@citi.com



Xinyu Ji is an Assistant Vice President on Citi Research's China economics team. Prior to joining Citi in Jul 2022, Xinyu worked at Macquarie in a similar role and as a research associate in China economics at another bank. Xinyu holds an MSc in Econometrics and Mathematical Economics from the London School of Economics, and a BA in Mathematical Economics from Fudan University in Shanghai. Xinyu was a joint winner of the Ely Devons Prize for her outstanding performance in the MSc of EME program at the LSE.

+852-2501-2792 | xinyu.ji@citi.com



Xiaowen Jin, CFA is a Vice President and an Economist in the Asia Economics team, based in Hong Kong. Prior to joining Citi Research, she worked as a Senior Research Assistant for Hong Kong University and as a Researcher at the Dutch Central Bank. Xiaowen finished her PhD in Economics in 2013 from the University of Munich and received a Master's and Bachelor's Degree in Economics from Zhejiang University. In her graduate studies, she specialized in Time Series Econometrics and Macroeconomic Forecasting. She is a CFA Charterholder.

+852-2501-2766 | xiaowen.jin@citi.com



Jin-Wook Kim is a Vice President and Citi Research's Chief Economist for Korea. He previously worked for Citi's Pan-Asia Economics team in Hong Kong for four years and Korea Economics team in Seoul for three years. Prior to joining Citi Research in 2014, he spent four years as an Economist at Samsung Life Insurance, covering the Korean macro economy and the Fixed Income market. Jin-Wook holds a Master's degree in Economics from New York University and a Bachelor's degree in Economics and Econometrics from the University of Nottingham.

+82-2-2077-4229 | jinwook.kim@citi.com



David Lubin is a Managing Director and Head of Emerging Markets Economics at Citi Research. Before joining Citi in 2006, David had worked at HSBC Group since 1989, where his career started in the field of sovereign debt restructuring negotiations. He has over 25 years of experience in emerging markets research. David has degrees from Oxford University and from the Fletcher School at Tufts University

+44-20-7986-3302 | david.p.lubin@citi.com



Xiangrong Yu is Citi's Chief China Economist, based in Hong Kong. Prior to joining Citi Research in 2017, he worked for China International Capital Corporation (CICC) for three years, where he was a China Economist advising institutional investors. His earlier roles include economist positions at Hong Kong Monetary Authority and International Monetary Fund. Xiangrong holds a Ph.D. in economics from the University of Wisconsin-Madison. He earned his M.A. and B.A., both in economics, from Peking University. Xiangrong has been frequently cited by international and Chinese media, and his academic work has appeared in leading journals.

+852-2501-2754 | xiangrong.yu@citi.com

Kathleen Boyle, CFA Managing Editor, Citi GPS

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It is said that "change is the only constant in life." This sentiment took on particular significance over the past few years as the COVID-19 pandemic raced around the globe. Whether it was personal shifts in how people worked and interacted or larger geopolitical shifts, change seemed to be all around us. As the pandemic increasingly becomes a thing of the past, there is a desire for things to go back to the way they were — get back to the office, start traveling again, and gather in large groups for holidays and events. But can the world really go back to the way it was?

In our December 2021 Citi GPS report on <u>*Global Supply Chains*</u>, we noted the pandemic forced corporates and governments to quickly adjust their supply chains to deal with border closings, lockdowns that kept production sites shuttered, and sudden shifts in demand as consumers spent more on merchandise than services. The lessons learned from the experience resulted in a shift from "just-in-time" to "just-in-case" inventory and a reassessment of global supply chains in general. Governments responded by categorizing certain industries as critical and vowing to produce certain goods domestically in the name of essential security.

In this new report, we look specifically at China and the drivers behind a shift in the country's development path towards self-reliance. China's 14th Five-Year Plan, released in 2020, announced a policy framework of "dual circulation" economics whereby China is rebalancing from an export-led "international circulation" strategy to one that focuses more on its domestic market through self-reliance, or "domestic circulation." This transition towards a more inward-looking growth model was given additional urgency in response to recent geopolitical events, in particular the U.S.-China trade war and tightening export controls on U.S. technology, and the sanctions imposed on Russia after the Ukraine invasion.

The report focuses on three areas in which China's pursuit of self-reliance seems especially clear: (1) technology and self-sufficiency in semiconductor development; (2) agriculture, where China can nearly secure its supply of staple grains but relies on imports of feed grains; and (3) energy, where dependence on natural gas imports has increased as part of a decarbonization push.

In order to address the challenges brought by China's inward tilt, the government elevated innovation to "core status" in its modernization. Technology decoupling amid U.S. protectionism has pushed China to focus its innovation strategy on self-reliance in technology upgrading, which may ultimately lead to China's Sputnik moment in innovation. Strong government spending on research and development, a large domestic market, and highly-skilled talent position China to increasingly compete with industrialized economies and a more normalized regulatory regime for platform companies should help minimize the risk of innovation being stymied.

Although self-reliance is the focus of the report, positive international spillovers will continue as China's import demand for food and consumers goods remains strong. In addition, other economies can benefit as labor-intensive manufacturing increasingly finds locations other than China.

Despite its inward turn to address the challenges of today's new world, China's global relevance will continue to only grow.

China's Inward Tilt

TOWARDS SELF-RELIANCE

China is moving towards a more self-reliant growth model that is increasingly state-dominated, inward-looking, and investment-driven. China's once export-driven economy started turning inward for economic reasons during the global financial crisis amid a softening in trade. But geopolitics, including U.S. sanctions and the Russia-Ukraine conflict, as well as ideology have now increasingly come into play.



DUAL CIRCULATION ECONOMICS: RESHAPING POLICY DYNAMICS

China introduced its "Dual Circulation Economics" (DCE) strategy in response to a hostile external environment following the U.S. trade war. DCE aims to rebalance the Chinese economy from "international circulation," based on external demand as a stimulus to growth, towards "domestic circulation," or increasing self-dependence. Recent geopolitical events such as the Russia-Ukraine crisis have further elevated DCE in importance.

Key Features of Dual Circulation Economics



Refocus on domestic demand expansion

Focus on the real economy, not finance



self-reliant innovation

Uphold high-level opening up





TARGET AREAS AND CONSTRAINTS

China's pursuit of self-dependence is especially clear in the areas of technology, food, and energy. In each of these – especially in technology – China is constrained in its ability to achieve pure self-reliance, but its efforts will characterize Chinese policy for the foreseeable future.

Technology

Developing competence in semiconductors is the key to China's pursuit of tech self-reliance, but there are many obstacles, including U.S. export controls and sanctions.

China Lags Industry Leaders in Chips



Source: SIA, Citi GPS

Food

The weak links in China's food supply system are more a feedstock problem – staple grains are largely secure but feed grain relies on soybean imports.

Grain Net Imports as % of Domestic Consumption



Source: Wind-Economic Database, Citi GPS

Energy

China's rising dependency on imported energy amid its decarbonization push raises the importance of energy security.

Net Fossil Fuel Imports as % of Domestic Consumption



Source: China Customs, NBS, Wind-Economic Database, Citi GPS

CHINA'S SPUTNIK MOMENT?

A broad trend of U.S.-China tech decoupling has pushed China to undertake an innovation strategy based on self-reliance via a "new wholenation system" that mobilizes resources for core technology breakthroughs. This shift may ultimately lead to China's Sputnik moment, and position it to increasingly compete with industrialized economies.



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Chapter 1: The Inward Tilt of Chinese Policymaking

"At present, economic globalization is facing an adverse current and protectionism is on the rise, but we must persist in keeping the door open for development. China's development should be down-to-earth and step-by-step, open, inclusive, mutually beneficial and win-win, and actively build a new development pattern with the domestic big circulation as the main body and the domestic and international dual circulation promoting each other. We should adhere to self-reliance, put the development of the country and nation on the basis of our own strength, and firmly seize the initiative in development. To build a great modern socialist country in an all-round way and achieve the second Centenary Goal, we must take the road of independent innovation. We must not wait to promote scientific and technological self-reliance, seize every day to break through the 'bottleneck' problem, and strive to master the key core technologies and equipment manufacturing industry in our own hands."

- President Xi Jinping, August 18, 2022

We think China's development path will be increasingly characterized by the pursuit of self-reliance, in which state-led investment spending plays an important role. An economy's development path can be considered across three

dimensions: the role of the private versus the public sector, the role of external demand versus domestic demand, and the role of investment versus consumption. This report considers China's future across these three dimensions, and the basic message is that China is moving towards a more self-reliant growth model that is increasingly statedominated and inward-looking compared to the past, but still likely to remain investment-focused. This transition towards a more inward-looking growth model has been with us since the aftermath of the Global Financial Crisis (GFC), but we think Beijing has given it additional urgency in response to actions by the administration of former President Donald Trump and the geopolitical implications of the Russia-Ukraine crisis. Of course, characterizing things in this way risks oversimplification, but the loss of subtlety is worthwhile for the sake of clarity. To focus our analysis, we consider three areas in which China's pursuit of self-reliance seems particularly clear: in technology, in agriculture, and in energy. What we find is that in each of these areas, and especially in technology, China's ability to achieve a pure form of self-reliance will be highly constrained, but that the effort towards that goal will characterize Chinese policy for the foreseeable future. The global implications of this are not especially encouraging.

In a sense, China is reviving a form of what some economists call "neo-

mercantilism." This is an idea most closely associated with Friedrich List, a 19thcentury German-American economist who articulated a "national" economics, in contrast with Adam Smith's "cosmopolitan" emphasis on free markets and individuals. A recent book on the topic defines this approach to economics as a reliance on economic activism on the part of the government, together with the use of strategic trade protectionism, as a means to promote national wealth and power.¹ Although neomercantilism in this sense is rooted in 19th century economic tradition, it might be worth reviving as a way of thinking about Chinese economic policy in the 21st century, since the basic contours of a neomercantilist way of thinking — as China becomes more state-oriented, more protectionist, and more inward-looking — seem less and less liberal in the Adam Smith sense. Arguably, this is not purely a Chinese phenomenon, as protectionism and industrial policy also become increasingly visible in the United States and Europe.

¹ Eric Helleiner, *The Neomercantilists: A Global Intellectual History*, Cornell University Press, 2021.

China's inward tilt is nothing new, in a sense: The economy has become

visibly more self-reliant since the GFC. Figure 1 and Figure 2 illustrate this point. The 2010s, roughly speaking, saw a sharp decline in the contribution of net exports to GDP growth, and that story is reflected in the declining ratio of exports to GDP. That was, to begin with, the result of a purely economic phenomenon, namely the decline in external demand growth that resulted from post-GFC belt-tightening in the West, the eurozone crisis, and a general softening of global trade growth in the post-crisis years. A gloomy external demand picture encouraged Chinese policymakers to deliver investment-led stimulus to the domestic economy in a number of phases, all of which had the effect of raising the role of domestic spending in generating GDP at the expense of exports. Yet although China's inward tilt may have started out as a response to purely economic phenomena, recent years have seen two other factors come to play an increasingly important role: geopolitics and ideology.

Figure 1. The Contribution of Net Exports to GDP Growth Saw Its Peak in the Years Running Up to the Great Financial Crisis of 2008...



Figure 2. ...Which Also Marked a Peak in the Ratio of China's Exports to GDP



Source: Citi GPS

Although China's inward tilt may have started as a purely economic phenomenon, geopolitics has supercharged China's pursuit of self-reliance.

In the post-GFC environment, an emphasis on self-reliance in China could be understood simply as an effort to wean the economy off a dependence on external demand growth that had become unreliable in the wake of the crisis. These days, though, it seems insufficient to think about self-reliance as a choice purely motivated by economics. The punitive economic policy measures the U.S. imposed on China during the Trump administration gave China further impetus to pursue self-reliance, since it had become clear that China's access to international markets was becoming increasingly constrained.

More recently, Russia's invasion of Ukraine is another factor that will likely intensify China's pursuit of self-reliance. Given the risks of future scenarios in which China might confront coordinated sanctions in the way that Russia has — especially the sanctioning of Russia's central bank, which overnight left the government without access to hundreds of billions of dollars' worth of purchasing power — China's authorities are very likely considering what their policy options are to minimize the effect if similar policies were in future aimed at Beijing. We think that in order to minimize the impact of any potential future coordinated sanctions, China would have three apparent options: (1) to find "sanction-proof" assets in which to invest its reserves, (2) to accelerate the internationalization of the renminbi, or (3) to structurally reduce China's economic dependence on the West.2 Of these three options, only the last appears truly reliable in the relatively near term. And it has the advantage of building on a strategy that China already has in place, namely, the Dual Circulation Strategy (DCS) also referred to here as Dual Circulation Economics (DCE).³

The centerpiece of China's growing emphasis on self-reliance is the Dual Circulation Strategy. This was first formally announced at a Politburo meeting in May 2020, and sets out a rebalancing of the Chinese economy away from "international circulation" (the first kind of circulation on which China has relied, namely, reliance on external demand as a stimulus to growth) towards "domestic circulation," or increasing self-dependence. A fuller discussion of the DCS can be found in the next chapter of this report, but for now it suffices to say that the Strategy clearly defines domestic circulation as the mainstay of the Chinese economy in the future.

In some ways this represents an important generational change in the way China will interact with the rest of the world. As far as we know, the term "international circulation" originated in 1988 when a government researcher, Wang Jian, made the case that China should adopt an export-led growth strategy, making use of its huge surplus labor to plug the economy into the international manufacturing process. In that sense, the de-emphasis of international circulation is an important historical shift. In a *People's Daily* article in November 2020, Vice Premier Liu He set out a number of objectives relating to the DCS including: (1) the priority of upgrading of China's technological capacity, including an enhancement of China's supply chain resilience (though referred to in this article as "optimizing the structure of supply"); (2) the need for finance to serve the needs of the real economy; and (3) the promotion of further urbanization. Any mention of external demand comes last.

While DCE seeks to define China's relationship with the world, by itself it leaves two questions unanswered. Considering the three dimensions referred to at the start of this chapter, DCE by itself only really addresses the balance between external and domestic demand in shaping GDP. By contrast, it is basically silent both on the relative role of the private and public sector, and on the balance between investment and consumption — although Vice Premier Liu's November 2020 article does call for China's policymakers to "comprehensively promote consumption."

² David Lubin, "Lessons of Sanctions on Russia for China," *East Asia Forum*, March 29, 2022.

³ This report uses the terms "Dual Circulation Economics" and "Dual Circulation Strategy" interchangeably.

Figure 3. After a Period of Liberalization That Saw Private Firms Dominate Fixed Asset Investment, the State's Role Has Revived... Figure 4. ...Which Seems to Be Echoed in the Private Sector's Declining Share in a Number of Activities



%) Share of Private Investment in the Domestic Enterprise by



As far as the role of the state is concerned, it does seem that state-level activism and industrial policy are increasingly apparent in China today. Earlier

we highlighted the idea that geopolitics seems to be influencing Chinese economic policy, but it is equally valid to argue that ideology is having an impact. President Xi Jinping is often understood to be deeply influenced by Marxist ideology, and the 19th Party Congress in October 2017 saw him emphasize the need for "stronger, better, and bigger" state-owned enterprises (SOEs).⁴ It is tempting to see a connection between this new official emphasis on the role of the state in the economy and the fact that SOEs' importance in generating fixed-asset investment has grown considerably since the 19th Party Congress. This is illustrated in Figure 3, which suggests that 2020 was the first year since 2005 in which SOEs accounted for more than one half of total fixed-asset investment. Within the services sector, this reassertion of the role of the state in the Chinese economy seems particularly evident in leasing and banking (Figure 4), but it is also evident in other areas of the economy. As for the role of industrial policy, Chapter 3 in this report discusses China's pursuit of technological self-reliance in which industrial policy — most famously through Beijing's Made in China 2025 strategy — features prominently.

It is not that the private sector is being eclipsed, more that its role is changing in what some have called a "two strong hands" approach. The idea of an

eclipsed private sector may seem superficially attractive from the 2020-21 crackdowns on private firms in the tech sector, in private education, and in the gaming industry. Yet what is going on here cannot be simplistically reduced to a "private bad, state good" framework. Indeed, support for private sector development is evident in a number of ways in recent years, from the effort to simplify the process of registering businesses to a new bankruptcy law and greater reliance on the court system to successfully adjudicate commercial disputes. One academic, Chang-Tai Hsieh of Chicago University, has talked about this as a "two strong hands" approach: one hand limiting excessive corporate power, the other seeking to nurture a thriving small and medium-sized enterprise (SME) sector.⁵

⁴ China News Service, "<u>China to Create Bigger, Better, Stronger State-Owned Firms</u>," October 20, 2017.

⁵ Chang-Tai Hsieh, "Two Strong Hands: China's Vision for the Private Sector," *The Wire China*, May 22, 2022.

This way of thinking might be easily connected to a principle that President Xi has expressed support for in his writings, namely a "traffic light system" for private capital, in which the authorities decide what kind of investment spending is appropriate for the private sector and what kind should be best left to the authorities themselves. One important question that results from this is whether a new approach towards the division of labor between the private and public sectors in China will do any damage to "animal spirits," or the willingness to take on project risk, within the economy. Or, to phrase the question as we put it in Chapter 6 of this report: Is China sufficiently innovative to meet its goals?

An additional feature of China's inward tilt is the role of protectionism, which seems increasingly evident as an approach to policymaking. We have noted in other research the growing role of protectionism globally. In effect, there is a kind of vicious circle at work: Rising protectionism impedes the growth rate of global trade, while at the same time slower trade growth inclines countries to adopt more protectionist policies. What we consider to be the best source of data on global protectionism — Global Trade Alert, based at the University of St. Gallen suggests that China has been the second-most important source of protectionist measures in the past 10 years after the U.S. (Figure 5). That said, the granularity of the data we have about what measures China has imposed is relatively low, and Figure 6 shows the vast majority of those measures can only be lumped into the imprecise category of "other subsidies." Since those subsidies are likely to be related to the task of supporting Chinese exports rather than limiting Chinese imports, we need to think about the idea of China's inward tilt a little more broadly to consider this as part of our theme. What we consider here is China's preference to maintain its current account surplus, which came dangerously close to a deficit in 2018. An important aspect of a neomercantilist bias in China's economic policy will be the continued emphasis on running current account surpluses: Current account deficits increase the rest of the world's financial claims on China, increasing the economy's dependence on the "kindness of strangers," i.e., other nations to keep financing those deficits. Since that kind of dependence is not in keeping with the pursuit of self-reliance, we think a preference for surpluses will remain a critical part of China's policy framework. One way of ensuring this is to emphasize the role of import substitution; for that reason, Chapters 3, 4, and 5 will focus on the theme of import substitution in three critical areas: technology, food, and energy.

Figure 5. China Ranks a Close Second to the U.S. When It Comes to Introducing Trade Restrictions During the Past 10 Years...

Figure 6. ...Though the Vast Majority of China's Protectionist Policies Take the Form of a Variety of Subsidies



tions During the Past 10 Years... Take the Form of a Vari

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China's growing self-reliance still leaves unanswered a crucial question about the Chinese consumer. In the past decade or more, there has been an active debate around the idea of China's economy rebalancing away from its dependence on investment spending and towards a more consumer-driven pattern of activity. As Figure 7 suggests, the overall size of the Chinese economy has caught up with the U.S. much more reliably than Chinese consumer spending. That discrepancy has given rise to the argument that a consumer-oriented rebalancing is necessary, especially since some economists argue that Chinese workers have effectively subsidized the development of the Chinese economy in recent decades by accepting low wages in the pursuit of profit-maximization by firms.

The future of consumption in China is pretty bright, but although creating a consumer-driven economy is important, it is probably not the main goal of

policymakers. The debate around Chinese consumption is often framed by noting the gap between Chinese consumption as a share of GDP (around 62%) and that share in the U.S. (closer to 70%). In our view, this is not a very helpful way to assess the health of a population's consumption possibilities. As Figure 8 makes clear, China's consumption-to-GDP ratio in the 1970s was close to where the U.S. ratio is today. Yet no one would describe Mao-era China as any kind of consumer's paradise, and so it seems right to consider these ratios with a grain of salt. In other words, it is quite possible for the Chinese economy to deliver greater opportunities for consumption without consumption being a specific target for policy. In fact, to the extent that geopolitics is driving Chinese economic policy these days, it is likely that investment spending continues to be the mainstay of Chinese GDP.

Figure 7. The Overall Size of the Chinese Economy Has Caught Up With the U.S. A Lot More Reliably Than Chinese Consumer Spending Has...

(%) China's Economy Relative to the U.S. 80% 70% 60% 50% 40% 30% 20% 10% 0% 1980 1990 2000 2010 2020 China Share of U.S. GDP China Share of U.S. Consumption Source: Haver, Citi GPS

Figure 8. ...But the Private Consumption Share of GDP May Not Be the Most Reliable Gauge of Consumer Satisfaction



Two factors above all are likely to sustain the development of the Chinese consumer: the growth of the middle class and rural wealth effects. Under the Organisation for Economic Co-operation and Development (OECD) standard of household income between \$10 to \$100 per person per day in 2005 PPP (purchasing power parity) terms, 74% of Chinese urban households enjoyed middle-class status as of 2021; this corresponds to 677 million people, more than double the total U.S. population of 331 million. The share and the size of the middle class are set to expand further, given the fact that household disposable income has been growing faster than GDP in the real terms in the past few years (except 2016), a trend likely to extend into the future. At the same time, the unlocking of wealth effects should help the consumer.

As we will discuss, the "rural vitalization strategy" (see Chapter 4) could unlock total rural land wealth of RMB150 trillion (\$21.1tn).⁶ Divided by rural population, this is about RMB190,000 per capita — around 13 times China's rural disposable income per capita. Chinese urban residents have already accumulated a huge amount of wealth in property, which, at current market prices, we estimate to be as much as RMB327 trillion.

However, it will take solid work to make China a consumer society. One

obvious point is that rapid growth will support a consumer-oriented transition, and given the many growth-related challenges that China is currently facing, it is difficult to be immediately optimistic on this point. Second, it is often argued, correctly, that a boost to consumer spending in China will require more confidence on the part of households that they can reduce precautionary savings and consume more. As a result of this, confidence about the future of Chinese consumption requires confidence about policies that will allow Chinese households to reduce their saving. That means deeper and broader universal medical coverage and more generous pensions, especially by lowering employee contributions to the social security system. Third, following the point in the paragraph above, land reform will be needed to further empower rural consumers. Finally, stabilizing home prices and making housing affordable for young couples will not only help boost consumption but also increase fertility in Chinese cities. In that sense, the government's current effort to wean the Chinese economy off its dependence on real estate investment could boost consumption somewhat in the long run, though in the short run, consumer confidence will remain constrained by a negative wealth effect as the growth in housing prices is suppressed.

In conclusion, we think that China's inward tilt will produce an economy that remains investment-focused, state-driven, and neomercantilist. An important question that follows, of course, is: Will it work to keep China's growth rate acceptably high? To some extent that depends on whether China has the capacity to remain as innovative as it has in the past, and that issue is the subject of Chapter 6. Another question is: What are the international implications of China's strategy? We discuss this in Chapter 7. If China succeeds in boosting domestic market share, this could pose challenges to Germany and Japan (in vehicles, machine tools, and robotics), South Korea and Taiwan (especially in semiconductors and other computer equipment), and to the U.S. (in agriculture machinery, aerospace, electric vehicles, and biotech). China's attempts to develop its own domestic semiconductor industry will be of particular focus given its importance in modern electronic machineries, its lingering technology gaps and vulnerabilities revealed from the export controls imposed during the U.S.-China trade tensions, and ongoing pandemic-exacerbated chip shortages.

Since Dual Circulation Economics is the most important overarching framework for China's inward turn, the following chapter aims to examine the elements of this strategy. We discuss how infrastructure remains a vital prerequisite to allow the government to fulfill its ambitions in making the domestic wheel the mainstay of the Chinese economy.

⁶ Currency conversions throughout the report are as of October 5, 2022.

Chapter 2. China's Dual Circulation Economics

Dual Circulation Economics was introduced to confront a more hostile external environment, and the Russia-Ukraine crisis should have elevated its importance further. It is a refocus on the domestic economy, with security higher on the priority list. Of the various ways of prioritizing domestic circulation, we believe infrastructure investment has become a major multi-year theme.

Dual Circulation Economics (DCE) is best understood as China's response to what it sees as a more hostile external environment. Following the prolonged

U.S.-China trade war, the Communist Party of China (CPC) leadership adopted a more cautious assessment about the external environment, warning that "the world is undergoing changes unseen in a century." On the demand side, world trade intensity, measured in several ways, has largely stalled since the Great Financial Crisis (GFC), and the rise of protectionism has imposed significant uncertainty on external demand. On the supply side, the U.S. has focused its efforts on Chinese technology companies using a variety of legal and regulatory tools to limit technology transfer to China. This has increasingly revealed China's vulnerability in its foreign dependence for core technologies. The rivalry with the U.S. for technological leadership could undermine the stability and even threaten the security of China's supply chains. When the "international circulation" fails to work well, it is natural for China to look more at the "domestic circulation," with President Xi introducing the idea of DCE in mid-2020. To be fair, China attempted to create a new wave of globalization when the first wave subsided post-GFC, but these efforts met pushbacks and constraints. Notably, the once high-profile Belt and Road Initiative (BRI) has been met among some observers with loud accusations about a "new colonialism" and faced a dollar constraint, with the greenback as the dominating funding currency.7

DCE has assumed even greater importance in the wake of Russia's invasion of Ukraine. China certainly has taken note as the Ukraine crisis led to a series of coordinated sanctions and penalties against Russia.⁸ The sanctioning of the Russian central bank, which resulted in Russia losing access to hundreds of billions of dollars worth of foreign exchange reserves, will have had particular resonance with policymakers in Beijing. It is not a large stretch of the imagination to consider the risk of future scenarios in which China might one day face sanctions from many of the countries that targeted Russia. The tensions across the Taiwan Strait in August 2022 following U.S. House Speaker Nancy Pelosi's trip to Taipei were a further reminder of how rapidly risks can escalate. In addition, China is now increasingly physically segregated from the rest of the world because of its "dynamic zero-COVID" (DZC) policy. The supply chain disruptions experienced since the COVID-19 pandemic perhaps also strengthen the case for a more resilient domestic circulation (Figure 9).

⁷ Lucy Hornby, "Mahathir Mohomad Warns Against 'New Colonialism' During China Visit," *Financial Times*, August 20, 2018; David Lubin, "Dollar Constraints May Lead to More Multilateral Approach for China's Belt and Road," Chatham House, October 23, 2018.

⁸ Laura Kelly, "China 'Learning Lessons' From Russia War in Ukraine, Intelligence Officials Say," *The Hill*, May 10, 2022.



Rebalancing from export-led to demand-driven growth is also a reflection of

China's own economic size. China's foreign trade dependency ratio, measured as the ratio of total goods trade to GDP, peaked at 64.2% in 2006 and has fallen continuously to 35.8% in 2019 (before the COVID-19 pandemic) and to 34.2% in 2021 (Figure 10). On the one hand, it is simply unsustainable for an economy generating over \$17 trillion to rely much on demand. China's current trade dependency remains much higher than the U.S., at 20%, or Japan, at 31%. Since China's entry into the World Trade Organization (WTO) over two decades ago, its share in global manufacturing value-added has risen from less than 6% to nearly 30%, and as a trade and manufacturing powerhouse, China also faces increased protectionism. On the other hand, the purpose of economic growth is to raise people's living standards, which necessarily means the willingness and capacity to consume more. The CPC pledged to boost the people's "sense of gain" as an element of its pursuit for the quality of growth as adopted by the 19th Party Congress. The transition is essentially to boost and upgrade domestic demand.

The concrete reform measures to facilitate DCE are reshaping the policy dynamics in China. Similar to the supply-side reform for the 13th Five-Year Plan (FYP), covering 2016-21, DCE is the organizing framework for the 14th FYP (2021-25). Here are the key features of DCE:

Refocus on Domestic Demand Expansion. The framework of DCE underscores the importance of a strong domestic market and sets domestic demand expansion as a strategic underpinning. Consumption will be promoted comprehensively together with investment expansion. Along with promoting new infrastructure in areas such as intelligent cities, DCE will improve the weak links in traditional infrastructure. Investment should maintain "reasonable growth" before consumption fully emerges as an engine for growth.

- Focus on the Real Economy, Not Finance. DCE stresses the development of the real economy. There should be a balanced development of finance and real estate with the real economy. Financial reforms will be promoted, while financial regulations should be tightened.
- Elevate Economic Security to the Highest Level Ever. DCE also calls for integrating development with security. In economic areas, the policy attention goes to food security, energy and strategic minerals security, technological selfsufficiency, financial stability, and protection over overseas interests, among others. Economic security, in a sense, has assumed greater importance than the pursuit of growth.
- Forcefully Push Forward Self-Reliant Innovation. DCE calls for "technology self-dependence and self-strengthening" and a "new whole-nation system" to mobilize resources for core technology breakthroughs.
- Uphold High-Level Opening Up. While DCE puts domestic circulation at the core, China will not cut itself off from the rest of the world. The country could accomplish both aims by leveraging the advantages of its large market to promote international cooperation. The Belt and Road Initiative in the next stage will require "high-quality development."

Figure 10. China's Foreign Trade Dependency Ratio Peaked at 64.2% in 2006 and Has Since Continuously Lowered to 34.2% in 2021



Of the various ways to prioritize domestic circulation, infrastructure investment has seemingly become a major theme. The CPC leadership has been suggesting "appropriately advancing infrastructure investment" at various meetings. Notably, President Xi chaired the 11th meeting of the Central Committee for Financial and Economic Affairs (CFEA) in April 2022 and called for "all-out efforts to build a modern infrastructure system." The tendency to shift away from infrastructure investment during the extended deleveraging campaign may have come to an end, allowing infrastructure investment to embark on a new path, at least, for normal growth. Indeed, the authorities' intense focus on infrastructure is reflected in the shape of economic stimulus policies during 2022: While support for real estate investment has fallen significantly down the list of government priorities, official support for Chinese infrastructure investment has been overwhelmingly evident.

From a long-term perspective, China remains underdeveloped and

unbalanced even in some traditional infrastructure. To illustrate, China ranks second globally by length of railways and has built the world's largest high-speed rail network. However, its rail mileage per capita still falls far behind G20 peers (Figure 11). The contrast also holds true for roads. When it comes to pipeline network, the U.S. is 24 times the size of China in total length and would exceed it far more in length per capita. In the meantime, the vast hinterland of China is less developed and still needs significant investment. For example, the length of paved roads per capita in Henan province in central China's Yellow River Valley is only one-fourth of that in the coastal province of Jiangsu (Figure 12). Of even greater concern, 17% of China's population living in villages and towns still had no access to clean water supply by 2020, despite years of "rural vitalization." The high-quality growth model calls for more investments in living facilities and conditions.

Figure 11. China Still Falls Behind G20 Peers in Railway Length Per Capita Despite Ranked 2nd Globally in Total Length



Figure 12. Road Infrastructure Gaps Are Significant Across Provinces



China's industrial upgrade will rely on boosting investment in what the authorities call "new infrastructure." In 2018, the government introduced the concept of new infrastructure to include efforts to: (1) support new technologies like 5G, big data, artificial intelligence, blockchain, cloud computing, and robotics; (2) link traditional infrastructure to software, with the aim of creating smart cities and intelligent energy networks; and (3) drive innovation and technological development.⁹ Whereas traditional investment infrastructure has supported China's emergence as a global manufacturing center, new infrastructure will be the foundation for its technological and structural upgrading, and this has just started to take shape.

⁹ Citi Research, <u>New Infrastructure: Investing for Both Growth and Upgrade</u>, March 5, 2020.

Is China considering a "New Deal" for infrastructure to breathe more life into the Dual Circulation Strategy? While execution is yet to come, if China goes on a new infrastructure spending spree in response to the COVID-19 shocks, it may remind market participants of the New Deal in the U.S. As guided by the CFEA, China will strive to bolster the construction of:

- Network-based infrastructure for transport, energy and water conservancy (e.g., waterways, coastal and inland ports, smart grid, green energy bases, and oil & gas pipeline networks).
- New infrastructure for industrial upgrading in information, sci-tech and logistics (e.g., supercomputing, cloud computing, AI platforms, broadband networks, transportation hubs, and regional, general and cargo airports).
- Urban infrastructure (e.g., intercity railways, urban railways, underground facilities, flood control and drainage, public health emergency facilities, and smart infrastructure).
- Agricultural and rural infrastructure (e.g., high-standard farmland, country roads, cold-chain facilities, and water conservancy).
- National security infrastructure (see Figure 13).



Figure 13. A Modern Infrastructure System for China in the Eyes of Beijing

Source: Government reports, Citi GPS

If domestic demand is really to be the mainstay of China's Dual Circulation Strategy, then China will have to find some way to reduce its dependence on imported technology since China's very low level of self-sufficiency in semiconductors is a major source of strategic vulnerability. For that reason, the topic we turn to next is an analysis of China's ability to achieve tech self-reliance.

Chapter 3. Can China Achieve Tech Self-Reliance?

Developing competence in semiconductors is the key to China's pursuit of tech selfreliance, but the growing hostility in the US-China relationship means that it will be much more difficult for China to develop a capability in advanced node chips. We think China will eventually catch up in the semiconductor sector, but the obstacles are considerable.

China is the world's largest consumer of semiconductors, but its selfsufficiency in this realm is extremely low. IC Insights estimates that Chinese

domestic firms had a 6.6% self-sufficiency ratio in 2021.¹⁰ This degree of selfsufficiency rises to 16.7% when including foreign firms that have integrated circuit (IC) wafer fabrication plants (fabs) located in China (i.e., TSMC, SK Hynix, Samsung, Intel, UMC and others). By IC Insights forecasts, even including these multinational subsidiaries in China, the country's IC production in 2026 is only likely to reach 6.6% of the global total. A forecast by VLSI and the Semiconductor Industry Association (SIA) suggested China's share of global semiconductor fabrication capacity would reach 18% in 2025 and 19% in 2030, largely because of the export controls on semiconductor fab equipment.¹¹ In the fabless semiconductor sector, China contributed 16% of the global market in 2020, but its share declined to only 9% in 2021 amid U.S.-escalated export bans (see Figure 14). As evident from this brief paragraph, China has plenty of reasons to be willing to increase its IC output (see Figure 15), but geopolitics is constraining its ability to do so.

Figure 14. China Owned Only 4% of Global Integrated Circuit (IC) Market Share in 2021



Figure 15. The Gap Between China and Industry Leaders in Process Technology Capabilities Remains Large



Note: Nodes in high volume manufacturing Source: SIA Research, Citi GPS

¹¹ Semiconductor Industry Association, *SIA Whitepaper: Taking Stock of China's Semiconductor Industry*, July 2021.

¹⁰ Bill McClean, "Research Bulletin: China-Based IC Production to Represent 21.2% of China IC Market in 2026," IC Insights, May 18, 2022.

Breakthroughs in the semiconductor sector could be difficult for China. It is a

capital-intensive sector, requiring high research and development (R&D) expenditures and long investment cycles. Semiconductor development was not a top priority until 2014, when Beijing released the National IC Promotion Guidelines and established the National IC Development Investment Fund with RMB139 billion (\$19.5bn) in its first round and over RMB200 billion in 2019 in the second. Later in 2015, the Made in China 2025 plan set an ambitious 70% self-sufficiency target by 2025 (Figure 16), which given current progress, has no chance of being achieved. For now, at least, China's dependence on the economies that supply it with semiconductors — Taiwan, South Korea, Malaysia, and Japan especially — will remain intact.

Figure 16. Made in China 2025: Integrated Circuit (IC) Development Guidelines Targets Appear Difficult to Achieve

| 2015 Target | 2020 Target | 2025 Target |
|--|--|---|
| Achieve significant progress in semiconductor industry development. Build a funding platform and policy environment that is compatible with industry development IC industry revenue aggregate exceeds RMB350 billion IC design capability in key applications such as smart devices and communications to reach an advanced level globally 32 nm and 28 nm mass production Revenue from mid-high-end packaging and testing exceeds 30% Key equipment and 12" wafer be used in 46 nm and 65 nm production process | Narrow the gap with global leaders and strengthen business sustainability Industry revenue compound annual growth rate (CAGR) >20% World class IC design technology in smart devices, communication, cloud computing, Internet-of-Things, and big data Mass production in 14 nm and 16 nm node Packaging and testing technology achieve world leading level Penetrating into international material and equipment supply chain and establish an advanced and reliable ecosystem 40% self-sufficiency rate | World-class IC industry value chain A set of leading companies considered tier-1 players in the global semiconductor market 70% self-sufficiency rate |

Partly due to the sector's capital intensity, the gap between Chinese firms and global leaders in the semiconductor sector is significant. In the first place, China lags in terms of foundry technologies (Figure 17); Taiwan's TSMC, the industry leader, leads China's domestic foundry leader in technology by at least five years. TSMC started mass production of 16 nanometer (nm) chips in 2016, while China's leading foundry started 14 nm mass production only in late 2019 (note: smaller node sizes in semiconductors produce smaller transistors that are both faster and more power-efficient) and its 14 nm production line is highly dependent on U.S.-made equipment and software. The gap in lithography is even larger. China's leading lithography equipment can only be applied to 90 nm chips and a China-made immersion type lithography tool capable for 28 nm chips is not expected until end of 2022.¹² The U.S. has prohibited the primary extreme ultraviolet (EUV) lithography manufacturer from selling machines to China ---relevant for the production of 7 nm chips and lower — and in July 2002 pushed the manufacturer to also stop selling deep ultraviolet (DUV) lithography machines, relevant for 7 nm chips and above.¹³ The potential expansion of the export bans on lithography may significantly curb China's capacity to foster its semiconductor sector. It could be up to 20 years for China to catch up, according to the CTO of ASML.

¹² Prabir Purkayastha, "U.S.-China Chip War Continues," *Peoples Democracy*, August 7, 2022.

¹³ Jillian Deutsch et al., "U.S. Wants Dutch Supplier to Stop Selling Chipmaking Gear to China," Bloomberg, July 6, 2022.

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2 | 2020 | 2021 | 2022 | | 2023 |
|----------------|--------------------|----------|-------|-------|----------|--------|----------------------------------|-------------|------------|----------------------------------|----------|--------------|---------------|-----------------------|--------|------|
| TSMC | 40/45 nm 28nm | | | 20 nm | 16 nm | | <mark>10 nm</mark> | 7 nm | 7 nm+ | 5 | nm | 5 nm+ | 3 nm | | | |
| | | | | | | | | | | | | 6 nm | 4 nm | m <mark>FinFet</mark> | | |
| | | | | | | | | | | | | | | | | |
| Intel | 32 nm HKMG | 22 nm | | | 14 nm | | | | | | 10 nm | | | | 7 nm | |
| | | l ri-gat | le | | | | | | | | | | | | | |
| Samsung | 45 nm | 22/20 nm | | | 20 nm | 1/1 nm | 10 nm | | 7 | nm | 7 nm + 5 | nm | | 1 nm | 3 nm | |
| Jamsung | 43 1111 32/20 1111 | | | | 201111 | FinEET | FinFFT | | , | | | | | 4 1000 | GAA | |
| | | | | | | | | | | | | | | | | |
| Global Foundry | 40/45 nm 28/32 nm | | | | 20/22 nm | 14 nm | Paused advanced node development | | | | | | | | | |
| | | | | | | | FinFET | | | | | | | | | |
| | | | | | | | _ | | | | | | | | | |
| UMC | 40 nm | | | | Inm | | 14 nm | | | Paused advanced node development | | | | | | |
| | | | | | | | Fir | IFEI | | | | | | | | |
| China | 45 pm | | 40 nm | | | 20 nm | DolySiON | | 20 nm 20 n | m 14 nm | M | Vill continu | uo to dovolor | advancor | Inodos | |
| China | 65 mm 40 mm | | | | | | | HKMG FinFET | | | | | Inoues | | | |
| Source: Compar | ny data. Citi (| GPS | | | | | | | | | | | | | | |

Figure 17. Key Foundry/Integrated Device Manufacturer (IDMs) Technology Roadmaps

In addition to China's lack of advanced foundry technology, it also relies heavily on imported chips and components. China's National Silicon Industry Group's (NSIG's) 12-inch silicon wafers for 14 nm chips have entered the mass production stage, but its capacity at 300,000 units per month can hardly satisfy the demand, not to mention the visible gaps vis-a-vis industry leaders when it comes to price and quality. In addition, China does not have the intellectual property for electronic design automation (EDA) software, which is critical for designing cutting-edge logic chips. In the short run, the U.S. export bans will significantly slow China's R&D progress in 10 nm-and-below chip technologies.

China's restricted ability to make progress in these technologies remains, despite evidence that U.S. export controls and sanctions are not having much bite. The *Wall Street Journal* reported in August 2022 that U.S. technology exports to China have been remarkably robust in the years since the passage of the 2018 Export Control Reform Act, which was intended to restrict tech exports to China.¹⁴ According to the article, some 88% of applications for technology imports to China were approved by the U.S. Commerce Department in 2021. Conceivably this statistic reflects a form of self-screening by firms: U.S. firms might have a strong awareness of the kinds of goods that are unlikely to be approved, and so they do not seek approval, which boosts the approval ratio. In spite of this, however, it is also clear that semiconductor manufacturing equipment exports from the U.S. to China have risen steadily — reaching \$6.9 billion in 2021 compared to just over \$4 billion in 2019.

¹⁴ Kate O'Keefe, "U.S. Approves Nearly All Tech Exports to China, Data Shows," *Wall Street Journal*, August 16, 2022.

| Figure 18. The Measures to Lin | nit China's Semiconductor Sector Since the Start of the Trump Administration |
|---|---|
| Measure Type | Detailed Measures Against China's Semiconductor Sector |
| Export bans | The U.S. banned ZTE (Apr 2018), Fujian Jinhua Integrated Circuit (Oct 2018), Huawei (May 2019), five Chinese supercomputing companies (Jun 2019), eight Chinese tech companies related to video surveillance and artificial intelligence technology (Oct 2019) from purchasing of U.S. products by adding them to the Entity List. |
| | In May 2020, the U.S. Department of Commerce's Bureau of Industry and Security (BIS) additionally amended the foreign-direct product rule and the Entity List to restrict Huawei's ability to use U.S. technology to manufacture its semiconductors via foreign foundries. In August 2020, the BIS closed the "off-the-shelf" semiconductor loophole and changed the word "foundry" to "plant" to broaden the manufacturers subject to the restrictions. |
| | In December 2020, BIS announced the designation of 60 additional Chinese companies to its Entity List, including China's largest semiconductor manufacturer. |
| | In December 2021, BIS added 34 more Chinese entities to the Entity List, including Shanghai AisinoChip Electronics Technology Co., Ltd. (a manufacturer of security control chips) and Shaanxi Reactor Microelectronics Co., Ltd. (a designer of high-speed power semiconductors). |
| Prohibition of foreign investment transactions | Presidential actions officially blocked five foreign investment transactions based on Committee on Foreign Investment in the U.S. (CFIUS) recommendations in 1990-2019 — most related to China or the semiconductor industry. Many Chinese-led foreign investment transactions have collapsed before reaching the final stage in the CFIUS's review process. |
| CHIPS Act | Any entity that utilizes CHIPS Act funding is prohibited from "engaging in any significant transaction involving the material expansion of semiconductor manufacturing capacity in China" with exceptions being allowed for legacy technologies. |

Source: Congressional Research Service, PIIE, Citi GPS

U.S. sanctions and export controls are very likely to remain in place, and one should expect their effect to tighten over time. Since the eruption of the trade war in June 2018, over 200 Chinese firms and institutions have been added to the U.S. Entity List (Figure 18). The U.S. further issued a rule in May 2020 to restrict any foreign companies that use U.S.-made machinery and software to produce and design chips for Huawei. Under the administration of President Joe Biden, more Chinese firms with perceived military connections have been added into the sanction list. Reuters reported on August 1, 2022, that the U.S. government is mulling limiting shipments of U.S. semiconductor equipment to China's memory makers, including NAND maker Yangtze Memory Technologies Co (YMTC).¹⁵ If imposed, the measure is expected to ban exports of U.S. equipment to memory fabs in China that produce advanced NAND chips above 128 layers.

The enactment of the CHIPS Act of 2022 in August 2022 adds to sanctions against China amid a government-led international chip race. The main goal of the CHIPS Act is to fund \$52 billion in manufacturing grants and research investment and to provide a 25% investment tax credit to chip producers in the U.S.¹⁶ In particular, any entity that utilizes CHIPS Act funding is prohibited from "engaging in any significant transaction involving the material expansion of semiconductor manufacturing capacity in China," with exceptions being allowed for legacy technologies. U.S., Taiwanese, and South Korean chip makers operating semiconductor fabs in the U.S. will likely become beneficiaries of the CHIPS Act. China's trade associations and Foreign Ministry criticized the CHIPS Act for hindering innovation and all in all, the frosty state of relations is likely to increasingly inhibit technology transfer to China.¹⁷

¹⁵ Alexandra Alper and Karen Freifeld, "U.S. Considers Crackdown on Memory Chip Makers in China," *Reuters*, August 1, 2022.

 ¹⁶ Semiconductor Industry Association, "<u>Pass the CHIPS Act of 2022</u>," PDF, July 2022.
 ¹⁷ Takashi Kawakami, "China Trade Groups Blast U.S. CHIPS Act as Hindering Innovation," *Nikkei Asia*, August 11, 2022.

Given broadening sanctions, China's foundry sector may focus on an expansion of relatively mature nodes (i.e., above 14-28 nm). The U.S. Commerce Department is reportedly considering a ban of semiconductor

manufacturing equipment for 14 nm or below nodes and the U.S. government has continued to block shipment of EUV machines to China.¹⁸ Taiwan is highly likely to keep its technological supremacy in the foundry sector as global foundry capacity is dominated by Taiwan, particularity in advanced nodes below 10 nm.

| | Main Initiative | Subsidy Size |
|---|---|--|
| U.S. | CHIPS Act, FABS Act | \$52 billion federal investments; Investment tax credits |
| EU | European Chips Act | \$46 billion |
| Japan | Specified Advanced Information & Communication Technology Utilization and other initiatives | \$4.42 billion; Subsidies of up to 50% of setup costs |
| India | India Semiconductor Mission | \$30 billion on chip and tech supply chain; Support of up to 50% of project costs |
| China | The China Integrated Circuit Industry Investment Fund | \$20.7 billion for Big Fund phase one \$30.47 billion for phase two |
| South Korea | K-Semiconductor Belt Strategy | Up to 50% tax credits for R&D investments; 20% tax credits for manufacturing investments |
| Taiwan | Invest Taiwan Initiative | Tax credits at 20%; 15% of R&D tax credit; secure supply of land/water/electricity |
| Source: Citi GPS, Nikkei Asia ¹⁹ | | |

Figure 19. Government-Led International Chip Race

In the memory chip sector, the potential for U.S. semiconductor equipment export bans to China could limit capacity addition of both China's indigenous memory chip makers as well as foreign company-owned memory chip fabs in

China. The U.S. government is reportedly considering an export ban of semiconductor manufacturing equipment for NAND memory chips with more than 128 layers.²⁰ In the long term, such a ban will likely create a bottleneck in memory capacity addition beyond 2023E as two South Korean NAND chip makers are producing 30%-40% of their NAND chips from mainland China. Thus, headwinds against China's biggest NAND company and foreign company-owned memory chip fabs in the mainland of China could incentivize foreign memory chip makers to expand new fabs outside of China.

China may gradually expand chip manufacturing capacity towards 2030 despite potential hurdles. China's government may place a higher priority on self-sufficiency ratio regardless of the high learning cost. IC Insights expects that China-located chip production could increase to 21.2% of China's demand by 2026 from 16.7% in 2021.

²⁰ Alexander Alper and Karen Freifeld, "U.S. Considers Crackdown on Memory Chip Makers in China," *Reuters*, August 1, 2022.

¹⁸ Alexandra Alper, Karen Freifeld, and Stephen Nellis, "U.S. Mulls Fresh Bid to Restrict Chipmaking Tools for China's SMIC," *Reuters*, July 8, 2022; Stu Woo, "China Wants a Chip Machine from the Dutch. The U.S. Said No.," *Wall Street Journal*, July 17, 2021.
¹⁹ Cheng Ting-Fang and Lauly Li, "The Resilience Myth: Fatal Flaws in the Push to Secure Chip Supply Chains," *Nikkei Asia*, July 27, 2022.

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Boston Consulting Group (BCG) and the Semiconductor Industry Association (SIA) project that China's share of global chip manufacturing capacity could expand to 24% in 2030 from 15% in 2020, although that forecast was published in September 2020 before the U.S. government's 2021-22 bans and the passage of the CHIPS Act of 2022 in the U.S.²¹

Notably, efforts to restrict exports to China have serious implications for the U.S. tech sector too. In 2021, China imported \$433 billion equivalent of

semiconductors out of the \$556 billion worldwide market. The U.S. semiconductor sector used to depend on a self-strengthening loop to maintain its technological lead: It channeled the high profits generated from business to R&D spending to ensure a comfortable lead ahead of rivals and dominance in the high-end segment of value chains. A study by BCG predicts that a complete ban of U.S. semiconductor sales to China would cost U.S. companies 18 percentage points of global market share and 37% of their revenue in the long term.²² Another joint report by BCG and SIA estimates that fully self-sufficient local supply chains would require at least \$1 trillion in incremental upfront investment, incur \$45 billion to \$125 billion in incremental annual operational costs for the entire industry, and result in a 35%-65% overall increase in chip prices.²³ This state of affairs might help explain why U.S. firms seem relatively unwilling to restrict their tech exports to China, which may give China some breathing space in its pursuit of self-sufficiency.

Figure 20. Progress on China's Catch Up on 10-14nm Technologies

| Segment | Component | Details |
|-------------------|-----------------|---|
| Equipment | Etching machine | NAURA inductively couple plasma (ICP) etching machine for 14 nm process has entered the mainstream production line. AMEC's capacitively couple plasma (CCP) etching machine has covered 65 nm to 5 nm, and is developing below 5 nm. Yitang Semiconductor has the second largest market share in the world for rapid annealing products, and largest in dry degumming equipment. |
| | Lithography | SMEE lithography machine's application level is 90 nm, and the 28 nm immersion DUV lithography machine is expected to be delivered in 2022. However, to produce below 7 nm chip, ASML's EUV machine is necessary. |
| Material | Polishing fluid | Anjitek's through-silicon-via (TSV) polishing fluid has achieved mass production at the 14 nm node. |
| | Silicon wafers | NSIG's 12-inch silicon wafers (for 14 nm process) can be mass produced — current capacity is 300,000 units per month, which is expected to double in 2024. However, its price and quality still has some gap with industry leader. |
| Foundry | | China's leading foudry's 14 nm chip entered into mass production stage in late 2019. |
| Source: Media ren | oorts. Citi GPS | |

China's ability to absorb the shock of the tech-related export controls and sanctions that it faces will depend on a number of factors. The Chinese

government is now more than motivated to redouble its efforts in the semiconductor sector, partly reacting to the U.S. tech bans or embargoes. The "new whole-nation system" has been put in place to engage in semiconductor R&D. Given China has the market, is well endowed with financial resources, and could also attract engineering talents, it could be only a matter of time for the country to advance its semiconductor technologies. Meanwhile, we believe the sanctions will push Chinese firms to cut their reliance on foreign technologies. They could reorient their supply chains, step up their innovation efforts and eventually narrow the technology gaps.

²¹ Antonio Varas et al., *Government Incentives and U.S. Competitiveness in Semiconductor Manufacturing*, Boston Consulting Group (BCG) and the Semiconductor Industry Association (SIA), September 2020.

²² Antonio Varas and Raj Varadarajan, *How Restrictions to Trade With China Could End US Leadership in Semiconductors*, BCG, March 2020.

²³ Antonio Varas et al., *Strengthening the Global Semiconductor Supply Chain in an Uncertain Era*, BCG and SIA, April 2021.

The bottom-up efforts from firms could generate synergies with the top-down push from the government. In addition, China also has the potential to be a disruptor to the sector should it catch up with the global semiconductor leaders. In the areas where China could engage in mass production, it is likely supply gluts would take place. In short, we tend to think China would eventually catch up in the semiconductor sector but it would take hard work. One key question is China's capacity for innovation, a topic we return to in Chapter 6.

In addition to technology, we think another key area in which China seeks a form of inward-looking decoupling is in agriculture, where the pursuit of a greater degree of food self-sufficiency has emerged as an important policy goal. It is that to which we now turn.

Chapter 4. Can China Achieve Food Security?

China is far from being on the brink of any food crisis, but food security concerns dominate policymakers' thinking nonetheless. The weak links in China's food supply system are in reality a feedstock problem, rather than anything to do with staple grains. Government measures on high-quality food supply will come through, and the key is rural revitalization.

China has stepped up its focus on food security under Dual Circulation

Economics. As the geopolitical landscape changes and the Chinese economy grows larger, the security of primary products becomes a more central element of China's sustainable development than ever before. Food security is probably the number one priority of the 14th Five-Year Plan (2021-25). In August 2020, President Xi highlighted in an unusual way "the need to maintain a sense of crisis regarding food security, especially amid the fallout of the COVID-19 pandemic." He characterized food waste as "shocking and distressing," notably making the comment when China had been having years of good harvests. He urged the authorities to take immediate measures to strengthen legislation, supervision, and long-term mechanisms to stop the food waste. The "Clean Plate Campaign" has gained steam since his comments, with more and more canteens and restaurants now displaying anti-food waste posters and banners. In April 2021, the National People's Congress voted to adopt an anti-food waste law. Amid the prolonged lockdown in March-April 2022 in Jilin province, a major grain producer in China, the government made special arrangements to ensure the spring sowing.

China is far from being on the brink of any food crisis, but food security

concerns dominate policymakers' thinking nonetheless. Since the great famine of 1958-61, food security has long been an obsession of Chinese policymakers. As the world's largest agricultural producer, China is responsible for about a quarter of the world's total output. Partly due to the improvement of irrigation facilities and the wide use of fertilizers and pesticides, yields of grain production have improved steadily (Figure 21). China is now basically self-sufficient in grain supply and has developed greater food reserve capacity. And there is certainly no question that nutrition for Chinese residents has improved materially, with more choices for meals. China is not facing an immediate or a long-term threat of food shortages. Yet its net food import bill has been rising sharply, to some extent driven by feed grains (Figure 22).

Recent Years





Food security concerns have been activated by the U.S.-China trade war, the COVID-19 pandemic, and African Swine Fever (ASF). The painful tariff war once generated a significant gap in China's soybean supply. As the pandemic penetrated more deeply into global supply chains, prices for key staples soared in some parts of the world. Some countries moved to secure domestic supply by restricting exports, adding to the pressure. The agricultural commodities shock from the Russia-Ukraine conflict further underscored the importance of food security. The ASF outbreak led to a super food inflation cycle in China, starting from 2019 (Figure 23). These episodes show that even small problems in food supply can generate significant economic and social consequences in a country of 1.4 billion people.

Figure 22. ... And Yet China's Net Food Import Bill Has Risen Sharply in

In general, China's dependency on imports is low for rice, wheat, and corn, but much higher for soybean. The COVID-19 disruptions and the U.S.-China trade deal pushed up China's import dependency for wheat (6.6% in 2021) and corn (9.2%), but it remains to be seen whether this is transitory or not. For grains, as well as rice, risks mainly come from plant pests and diseases and even panic stockpiling by consumers. Trade partners' export bans are less worrying given China's foreign dependency ratio was as high as 79% in 2021 (Figure 24). This was already down from 89% in 2019 with the policy push on domestic production. The U.S. has been a major source for China's imports of soybean, wheat, and corn (Figure 25). Notably, over 90% of corn imports were from the U.S. in 2010-13, but in recent years, they were mainly from other countries, including Ukraine.

The overall situation, then, is that China can almost secure the supply of staple grains, while its food security issue is in reality a feedstock problem. In

other words, China is short of capacity to produce enough feed grains (such as soybean) to support its large and rapidly growing livestock industry. As demonstrated by the Russia-Ukraine conflict, the international market for feed grains can be complicated by geopolitical tensions and suffer from huge price volatilities. For human consumption, the grain supply has been remarkably safe and sufficient for China. Reflected in prices, the direct contribution of grain price growth to China's headline inflation has been minimal in the past decade (Figure 26).



Figure 24. China's Dependency on Imports Is Very Low for Rice, Wheat and Corn but High for Soybean



Figure 25. The U.S. Has Been One Major Source for China's Imports of Soybean, Wheat, and Corn





Figure 26. The Direct Contribution of Grain Price Growth to Headline Inflation Has Been Small in the Past Decade



But in keeping with a "Dual Circulation" ethos, food security has recently assumed a growing importance. The clearest expression of this was the No. 1 policy document of 2021, which followed on from China's declaration of victory against poverty in December 2020, and stated: "To revitalize the nation, rural areas must be revitalized." Rural revitalization has therefore come onto the front burner of concerns among Chinese policymakers, signaling renewed policy efforts for rural vitalization and agricultural modernization. Altogether, we see four issues in this:

Tackling Bottlenecks in Agricultural Technologies. The government has drawn a blueprint for the homegrown crop and animal breeding system. Protection, development, and utilization of agricultural germplasm resources will be strengthened and the implementation of major scientific and technological projects in agricultural biological breeding will accelerate. Efforts will also be made to strengthen support for modern agriculture, ranging from investment in science, technology and equipment; to the establishment of agricultural modernization demonstration zones, with the total number to reach about 500 by 2025; and the advancement of green development of agriculture. Indeed, China successfully improved agricultural productivity through market-based reforms in the 1980s and by intensive use of fertilizers and pesticides thereafter.

However, the impact of these reforms on productivity seems to have reached its limits, and the extensive use of chemical inputs has caused water and soil pollution. The government now looks for the next breakthrough in productivity from innovations of agricultural technologies, especially seed technology.

- Investing in Rural Infrastructure. The government is vigorously promoting rural infrastructure construction (such as road systems, power grids, clean energy, optical fiber networks, 5G mobile communications, and mobile Internet of Things), public services, rural demand, integration of rural and urban developments, budgetary support for priority projects, and agricultural reforms. Water supply facilities, logistics, and the power grid and transport infrastructure will be upgraded; and rural public education, hospitals, and cultural services will be enhanced. The government will continue to improve supporting infrastructure in resettlement areas, including public service facilities, industrial parks, and community governance capabilities. Relatedly, more will be done to improve rural industries such as the agricultural product processing industry to create more jobs in rural regions.
- Strengthening Farmland Protection. The government vows to hold the "red line" of 1.8 billion *mu* (120mn hectares) of arable land; strictly implement land use control; and build 100 million *mu* of high-standard farmland to ensure harvests, high yields, and stable production in 2022. The government will improve the subsidy system to incentivize the production of grain, pork, and others.
- Solidifying Poverty Alleviation Outcomes. The first step to support agriculture is to support farmers. China officially announced its victory against poverty in February 2021, declaring that all the rural poor have been lifted out of extreme poverty under the current standard and nearly 100 million impoverished people have shaken off poverty. China has also removed all impoverished counties from the poverty list. The next step is to solidify the achievements in rural development. For example, the government will strengthen assistance for low-income rural residents on a regular basis. It will also focus on large and medium-sized resettlement areas, and provide employment assistance to people who move there.

We see land reform as a key element of rural vitalization, and the 14th FYP will make realistic breakthroughs in the marketization of rural housing plots

(Figure 27). The latest amendment to Land Management Law, which became effective in 2020, introduced some important changes. It extended farmland use contracts for another 30 years upon expiry and allowed collectively-owned rural construction land to enter the market. Rural-urban migrants can exit their housing plots on a voluntary and compensated basis, but the transfer of the use rights to housing plots can only happen within the collective. Importantly, the No.1 document pledged to push forward housing plot reform and "explore effective forms for the realization of the separation of ownership, entitlement and use rights of housing plots," a prerequisite for the plots' marketization. The next foreseeable development is to partly dismantle restrictions on housing plot transactions that constrain the realization of the value of farmers' use rights.

Land reform would support rural consumption and development. Based on a set of "shadow prices," we estimate China's rural land wealth at around RMB150 trillion (\$21.1tn), with rural construction land worth RMB22 trillion and housing plots worth RMB73 trillion (Figure 28). The wealth effect of the construction land liberalization will be gradually unlocked in coming years. Rural households would also benefit from the enhanced use rights to farmland and housing plots. By unlocking the land value, the reform would increase farmers' wealth and property income and support their demand for automobiles, consumer electronics and other durables, as well as services. With an enhanced exit mechanism for housing plots, migrants may be more inclined to cash in their land wealth and settle down in cities than before, facilitating rural-urban migration. In the meantime, the extended tenure and strengthened protection should make farmers' use rights to farmland more tradeable. It should open the door for large-scale farming by agricultural enterprises and cooperatives.

Figure 27. Rural Land Consists of Farmland, Commercial Construction Land and Housing Plots



Figure 28. We Estimate That China's Rural Land Wealth Could Total RMB150tn, With Housing Plots Worth About RMB73tn

| | Ar | ea | Pri | ce | Wealth | | |
|-------------------|--------|-------|---------|---------|---------|--------|--|
| | sqm bn | mu mn | RMB/sqm | RMB/mu | RMB bn | USD bn | |
| Housing Plot | 113 | 170 | 648 | 431,774 | 73,402 | 11,088 | |
| Construction Land | 33 | 50 | 648 | 431,774 | 21,589 | 3,261 | |
| Farmland | 1,280 | 1,920 | 43 | 28,806 | 55,308 | 8,355 | |
| Total | | | | | 150,299 | 22,704 | |

Source: Citi GPS

In addition to a renewed focus in Beijing on technological self-sufficiency and food security, we also see China's strategy regarding green energy as part of a broader effort to double down on self-reliance and limit China's dependence on imported fossil fuels.

Chapter 5. Can China Limit Its Dependence on Imported Energy?

Energy security is not an immediate concern for China. However, China's rising dependency on imported energy amid its decarbonization push raises the importance of energy security in the medium and long term. New energy and new infrastructure will benefit from China's energy transition.

Energy security is understood by China's leadership as part of a broader concept of national security. As early as June 2014 in the 6th Central Committee for Financial and Economic Affairs CFEA meeting chaired by President Xi Jinping, the Communist Party of China (CPC) leadership outlined China's energy security strategy. The Action Plan to Achieve Peak Carbon Emissions by 2030, released in October 2021, also set energy security as a bottom line. The 14th Five-Year Plan (2021-25) provided concrete guidelines on promoting energy security and establishing a modern energy system.

To be sure, energy security is not, from an economic point of view, an immediate concern for China. The country's domestic energy production has been rising steadily since the supply-side reform in 2016 and can meet over 70% of domestic demand as of 2019 (latest available data). This is because coal still accounts for 56% of China's energy mix in 2021, and China is largely self-sufficient on that front.

However, China's dependency on imported energy is rising quickly as demand growth constantly outpaces domestic production. The dependency rose from the low single digits in the late 1990s to 24% in 2019 (see Figure 29). Oil and natural gas, which accounted for 27.4% of China's energy mix in 2021, contributed most to the increase (Figure 30). China's import dependency stood at 72% for oil in 2021, and rose quickly to 44% for natural gas from merely 1%-2% in 2007. The country's natural gas imports increased by 37 times between 2007 and 2021 under the push for clean energy. The price volatility of natural gas in the international market amid the pandemic and geopolitical risks could increasingly be a source of concern for China.

Figure 29. China's Energy Production Has Been Expanding Resiliently and Its Import Dependency Has Been Rising

Figure 30. China's Reliance on Imported Oil and Natural Gas Has Been Rising Rapidly



The decarbonization push is another factor behind China's call for energy

security. China aims to hit peak emissions before 2030 and carbon neutrality by 2060, as announced by President Xi at the UN General Assembly in 2020. The government has since been pushing forward with a series of actions (Figure 31), including urging local governments to set decarbonization goals, initiating carbon emission trading, further cutting steel capacity, and establishing credit facilities to firms for engaging in decarbonization. Notably, the Action Plan unveiled in October 2021 pledged to achieve the nationally determined contribution (NDC) target for climate change by 2030, and to reduce energy consumption and carbon dioxide emissions per unit of GDP by 13.5% and 18% within five years. These all suggest a strong determination to achieve the decarbonization goal (Figure 32).

During this move towards energy transition, a power crunch in the second half of **2022** revealed the weak links in China's energy system. Over 20

provinces rolled out electricity-rationing measures during August-October 2021. This was the result of an export-led industry boom during the post-pandemic recovery coinciding with the government's "dual energy control" policy to curb carbon emissions. Even for coal, for which China is mostly self-sufficient, the balance between supply and demand showed it could tighten quickly, with thermal coal price surging to the peak of RMB2,592 per ton in October 2021 from the bottom of RMB568 per ton in February 2021. With the painful power crunch episode in mind, the government has toned down the environmental push for the National People's Congress in 2022 and has not set an explicit target for energy consumption intensity as it had in past years.

Figure 31. Government Policy Actions on Decarbonization

| Date | Department | Details |
|------------|-----------------|---|
| 10.23.2020 | CERC | Sets carbon peak and carbon neutral as the key task for 2021 and pledge to intensify the financial support to green development. |
| 12.18.2020 | NDRC | Pushes forward the treatment of plastic pollution and enhance the control of energy consumption and intensity of energy consumption. |
| 12.22.2020 | NEA | The national energy meeting calls to enhance the energy supply and accelerate the development of wind, solar, water, nuclear power, and usage efficiency of coal. |
| 12.28.2020 | MIT | Calls for industrial low carbon activity and green manufacturing and pledges to reduce the output of crude steel to ensure a YoY decline in crude steel output. |
| 01.05.2021 | MEE | Unveils the management rule for carbon emission trading (ETS) and clarifies the first ETS contact cycle to initiate from January 1st. |
| 01.13.2021 | MEE | Calls for local governments to put forward clear peak attainment goals based on actual conditions, formulate carbon peak implementation plans and supporting measures, and encourage the key sectors (steel, construction, ferrous metals, chemical, coal, electricity) to provide concrete carbon peak target and implementation plan. |
| 03.19.2021 | Tanghshan Gov't | Tangshan releases plans for steel production cuts in 2021. Out of the 25 steel mills in Tangshan, seven are required to cut production by 50% during March 20-June 30 and 30% in the first half of 2021; 16 are required to cut production by 30% throughout the year. |
| 03.29.2021 | MEE | Unveils the notice to enhance the management of corporate carbon emission report to improve the information transparency of key sectors. |
| 03.23.2021 | 14th FYP | 14th Five Year Plan unveils the concrete steps to reach carbon neutrality by 2060. It aims to achieve the Nationally Determined Contribution target for climate change by 2030 and will reduce energy consumption and carbon dioxide emissions per unit of GDP by 13.5% and 18% within five years. |
| 06.10.2021 | PBoC | Release assessment plan for banking sector's green finance effort. |
| 07.08.2021 | MEE | After the approval from the executive meeting of the State Council, the national carbon emission trading market for the power generation industry launched for online trading in July. The next step is to steadily expand the coverage of the industry and use market mechanisms to control and reduce greenhouse gas emissions. |
| 10.26.2021 | State Council | Unveils action plan to achieve carbon peak in 2030. |
| 11.08.2021 | PBoC | PBoC launches new monetary policy facility to support decarbonization. |
| 11.09.2021 | NDRC | Unveils 14 FYP's national clean production plan. |

CEWC = Central Economic Work Conference, NDRC = National Development Reform Commission, NEA = New Energy Administration, MIIT = Ministry of Industry and Information Technology, MEE = Ministry of Ecology and Environment, PBoC = People's Bank of China Source: Government report, Citi GPS

The political will to meet its environmental targets remains strong in China, both for geopolitical reasons and for purely ecological reasons. At the UN General Assembly in September, 2020 President Xi pledged that China will reach peak carbon emissions by 2030 and carbon neutrality by 2060. Climate change is one of the biggest common challenges for all humankind. As the largest developing

one of the biggest common challenges for all humankind. As the largest developing country and the largest emitter, China's commitment matters to itself and the world. Meanwhile, climate is also one of the areas in which the U.S. and China can cooperate regardless of rising tensions between the two countries.

The CPC leadership is well aware of the cost that comes with its fast development. China's total carbon dioxide emissions remain on an upward trend (Figure 33), despite its emissions per GDP declining notably from around two kilograms (kg) per GDP in terms of PPP (purchase price parity) dollars to 0.5 kg in the past 30 years. Its CO₂ emissions exceeded those of the U.S. in 2007, making it the largest emitter in the world. As the largest consumer of fossil energy, China accounts for more than 30% of global carbon emissions (Figure 34). Its environmental quality is significantly lower than implied by its income level (Figure 35). In addition, "Ecological Civilization" is an essential element of "Xi Jinping Thought." China's commitment to peak carbon emission and carbon neutrality is by President Xi himself. He also sees ecological civilization as a prerequisite for economic development and higher-quality growth.

Figure 32. The Completion of 13th FYP Targets vs. 14th FYP Targets on Environmental Protection

| | 13th FYP Target | Completion | 14th FYP Target |
|---|--------------------|------------|--------------------|
| Reduction in energy consumption per unit of GDP (%) | 15 | 14.0 | 13.5 |
| Non-fossil energy (% of primary energy consumption) | 15 | 15.3* | 20 |
| Reductions in CO ₂ emissions per unit of GDP (%) | 18 | 18.2* | 18 |
| Air quality: Good days in prefectural + cities (% of year) | >80 | 87 | 87.5 |
| Surface water quality: Grade III or better (%) | >70 | 83.4 | 85 |
| Forest coverage (%) | 23 | 23.2* | 24.1 |
| Note: * means completion until 2019 Source: Government reports. Citi GPS | | | |

Figure 33. China's Total CO2 Emissions Remain on an Upward Trend





However, China has a long way to go to build a low-carbon economy, and the country's promotion of coal reflects political objectives above all. At the center

of China's environmental push is the transition of the energy structure. How to manage energy security while pushing forward the energy transition is the biggest challenge for China's energy policy. Fossil fuels still accounted for 84% of China energy mix in 2020, and the share of coal reached 56% (Figure 36). Note that the relatively high level of CO2 emissions from unit coal, which is almost double that of natural gas, made it the single most important emission source (Figure 37). However, coal will remain the most important part in China's energy mix in the coming years. Due to the recent painful experience from the power crunch, it is less likely that the government would step up capacity control on coal production. It would likely resort to cleaner usage of coal instead. China's National Development and Reform Commission issued nationwide standards on coal usage in May 2022. The People's Bank of China set up a special lending facility of RMB200 billion to support clean usage of coal in November 2021 and added another RMB100 billion in May 2022. The concern with natural gas, however, is that China needs to rely on imports. China has been the biggest natural gas importer since 2018, with the imports accounting for 37.7% of domestic consumption in 2021. That year, 39% of China's liquefied natural gas (LNG) imports came from Australia and 11% from the U.S.

90

2.0



4.0

4.5

5.0

log(GDP/capita in US\$)

5.5

Figure 35. China's Environment Quality Is Significantly Lower Than That Implied by Its Income Level

Note: GDP/capita data as of 2021 Source: Yale University, World Bank, Citi GPS

2.5

3.0

3.5

Wind power has been growing especially fast in recent years, and new energy (hydro, solar, wind and nuclear) as a whole is growing visibly. China's new energy is on the rise. Its share in the energy mix rose from 5%-6% in the late 1990s to 16% in 2020. China's wind power industry (Figure 38) and photovoltaic power industry have been growing rapidly (Figure 39) in recent years. New energy will be another card in China's energy transition deck. The government is also pushing hard on this front. The Action Plan and the 14th FYP both vowed to increase the capacity of hydro, wind, and solar power generation. Despite all of the merits of new energy, stability remains the top concern. Sluggish hydro power generation was one of the factors behind the power crunch in 2021, and the droughts of 2022 may also have the effect of reducing reliance on hydro power. In any case, new infrastructure (i.e., in areas like smart cities and intelligent energy networks) compatible with new energy will need to be built to facilitate the transition.



Figure 36. China's Energy Consumption Consisted of 56% of Coal, 18.5% of Oil, 8.9% of Natural Gas and 16.6% of Renewables in 2021

Figure 37. The CO₂ Emissions From Unit Coal Is Higher Compared With Natural Gas



Source: U.S. Energy Information Administration, Citi GPS

New infrastructure will be vital to ensure that China has the capacity to store

new sources of energy. Storage and transmission are two key pillars in this respect. Bloomberg reported in June 2022 that 12% of power generated by wind turbines in Inner Mongolia and 10% of solar power in Qinghai has been wasted because the grid could not digest it.²⁴ The Action Plan and the 14th FYP set an ambitious target for non-pumped hydro energy storage to reach 30 gigawatts (GW) by 2025. Ultra-high-voltage (UHV) electricity transmission is an example for transmission. China faces a huge mismatch geographically in energy supply and use: Coal, hydro, wind, and solar resources are very concentrated in the inland areas of the west, while the heaviest energy demand is along the urbanized east coast. China initiated UHV projects in 2006 and planned 25 alternating current (AC) lines and 14 direct current (DC) lines in the 14th FYP, with >30,000 kilometers of line length and a RMB380 billion investment in total versus 13 AC and 12 DC lines established during the 13th FYP (2016-20). Through 2030, the government expects electricity transmitted via UHV lines to hit 37 billion kilowatt hours (kWh) compared to 24 billion kWh recently.





Note kWth = kilowatt thermal Source: CEIC, Citi GPS Figure 39. ... So Has Its Photovoltaic Power Industry



Source: CEIC, Citi GPS

China's energy transition will have profound economic and investment

implications on multiple fronts. First, Beijing will likely make further policy adjustments to engineer a low-carbon trajectory. Indeed, the government may have to curb capacity expansion in traditional materials sectors and heavy industries. The market may also discourage capital expenditure investment in sensitive sectors via improved pricing of potential environmental risks. Second, eco-friendly sectors like advanced manufacturing and modern services, as well as clean energy technologies, are set to attract more policy support and financial resources. In particular, services made up 53% of China's GDP in 2021 amid the pandemic shock. We expect the share to further rise to around 60% by 2025.

²⁴ Bloomberg, "China's Renewable Energy Fleet is Growing Too Fast for Its Grid," June 5, 2022.

China has an incentive to green its vehicle fleet since rail and water transport are so much less important than roads. China has become the world's largest auto market since 2009. Its freight traffic also dominantly depends on road networks (75% in 2021), much more than on railway (9%) and water (15%) (Figure 41). There is no question that China will move to contain pollutant emissions from new motor vehicles, a major source of air pollution, by continuously upgrading emission standards, and continue its green overhaul to address issues like overloading and dust-raising by trucks. Further, new energy vehicles (NEVs, mainly electric vehicles) will remain a priority in order to combat pollution and reduce reliance on imported oil. Finally, the government has been taking measures to shift freight from roads to rail and waterway networks. In addition to high-speed rail, China is set to expand its investment to raise its rail freight capacity.

For the time being, greening China's road vehicle fleet will remain a major objective and, as the following chapter shows, China has a particular advantage in electric vehicles.

Figure 40. Heavy Industries Accounted for a Large Share of China's Carbon Emissions









Chapter 6. Is China Sufficiently Innovative to Meet Its Goals?

China's tech-decoupling from the U.S. means a paradigm shift in its innovation model — switching from relying on foreign companies for leading core technologies to self-reliance under a "new whole-nation system." At the national-strategy level, decoupling could be China's Sputnik moment — an external trigger for an era of fast-track technological progress.

It immediately follows from the Dual Circulation Strategy that China will have to become more innovative in response to external challenges. The 14th Five-Year Plan (2021-25) has elevated innovation to "core status" in China's modernization, positioning core technologies as a matter of national security. In a continually changing geopolitical setting, however, China's innovation model may need to shift more towards self-reliance.

Innovation in China used to take a bottom-up and market-driven approach based on its comparative advantage and international division of labor. The

early progress in innovation was mostly facilitated by globalization, with technology transfers and skill enhancement from foreign direct investment originating from developed markets, and more recently by the rapid spread of new technologies at lower costs, especially on the back of IT developments. This "bottom-up" and market-based pattern of technology catch-up followed the international division of labor based on China's comparative advantage. This model appeared to have served China well. The Global Innovation Index, published by the World Intellectual Property Organization, ranked China as the 12th-most innovative country globally among 129 economies in 2021 (Figure 43). The present momentum will likely catapult China to the fifth-most innovative country by 2030. While this model has allowed China to catch up quickly in certain sectors, such as artificial intelligence and 5G, it remains a distinct laggard in sectors such as semiconductors and aerospace engineering, sectors that require large investment in basic research. The lack of "core technologies" will likely make the country vulnerable to the external environment, in particular China's relations with the West and the U.S.



Figure 43. China's Innovation Performance Is Better Than Implied by Its Development Level, and Is Expected to Improve Further



Source: Global Innovation Index (GII), World Bank, Citi GPS, Bubble chart data as of 2021, Circle Size = Population

The 2015 release of the Made in China 2025 initiative was a watershed event, as it represented a major deviation from China's previous approach. Tight

timelines and ambitious targets were set for the 10 important sectors the government identified. They include robotics, new energy vehicles (NEVs, mainly electric vehicles), biotechnology, aerospace, high-end shipping, advanced rail equipment, electric power equipment, new materials, new generation IT and software (including integrated circuits and telecom devices), as well as agricultural machinery. The plan unsettled both the U.S. and European governments and their multinational corporations. China has toned down the Made in China rhetoric since its trade negotiations with the U.S., strengthened intellectual property (IP) protection, and abandoned the practice of offering market access in exchange for technologies. However, technology dominance has still emerged as a key dimension in the strategic rivalry between the U.S. and China. The Trump administration heightened its sanctions on Chinese firms and barred non-U.S. companies that use U.S.-made machinery and software from supplying key components like chips to China. The broad trend of U.S.-China technology decoupling continues under the Biden administration.

The tech-decoupling could serve as China's Sputnik moment in innovation, forcing it to take a top-down and self-reliant approach. Beijing quickly

recalibrated its technology and innovation policy during the Communist Party of China's 5th Plenum in November 2020. Self-reliance via a "new whole-nation system" appears to be a key feature of China's innovation going forward. While foreign partnerships are still crucial (for hedging supply chain risks), China will have to rely more on its domestic companies and talents to drive innovation in the future. More efforts are going to be devoted to developing backbone technologies, investing in new infrastructure, and maintaining a competitive advanced manufacturing sector. The state will prioritize its resources to engage in technological breakthroughs in areas subject to export bans or relying exclusively on imports. The Chinese Academy of Sciences identified the top 35 sectors that rely most heavily on imports as priorities for indigenous breakthroughs (Figure 44). Selfreliance is far from a guarantee of successful innovations, but it may be a defining feature of policy in a decoupling world.

Figure 44. Top 35 Technology Sectors in Which China Relies Excessively on Foreign Imports

| # | Sector/Product Name | # | Sector/Product Name |
|--------|--|----|--|
| 1 | Lithography | 19 | High-pressure plunger pump (hydraulic equipment component) |
| 2 | Chip | 20 | Design software for aviation |
| 3 | Operation system | 21 | Photoresist (for chip production) |
| 4 | Aircraft engine nacelle | 22 | High-pressure common-rail system (core for diesel engine) |
| 5 | Tactile sensor (for industrial robot) | 23 | Transmissive capacitor (core component for life sciences frozen capacitor) |
| 6 | Vacuum evaporation machine (display panel production tool) | 24 | Road-header's main bearing |
| 7 | Cellphone radio-frequency device (conversion component from digital signal to electromagnetic wave) | 25 | Microspheres (key material for panel production) |
| 8 | iCLIP tech (key tech for brand-name drug's R&D) | 26 | Underwater connector (undersea observation network) |
| 9 | Heavy-duty gas turbines (component for ships, trains, large-scale power station) | 27 | Key material for fuel battery |
| 10 | Lidar (automatic driving system) | 28 | High-end welding power |
| 11 | Airworthiness Standard (assessment for aircraft engine) | 29 | Lithium battery separator |
| 12 | High-end resistor capacitor | 30 | Medical imaging equipment component |
| 13 | Core industrial software, e.g., EDA tool for chip manufacturing | 31 | Ultra-precision polishing process (basic tech for manufacturing) |
| 14 | Indium tin oxide material (for the production of monitors) | 32 | Epoxy resins (key material for carbon fiber) |
| 15 | Core algorithm for robots | 33 | High-strength stainless steel (key material for rocket engine) |
| 16 | Aviation steel (e.g. for big plane landing gear) | 34 | Database management system |
| 17 | Special steel knife (core component to maintain high-speed train) | 35 | Scanning electron microscope (high-end electron optics) |
| 18 | High-end bearing steel (e.g., for airplane, high-speed train) | | |
| Source | e: Science and Technology Daily, Citi GPS | | |

Decoupling will certainly slow China's technological advances, but there is no need to be overly pessimistic about the intrinsic ability of Chinese firms to innovate. Sanctions on technology like semiconductor chips have slowed China's 5G ambitions and even put some companies' survival in question. However, the government is now devoting more resources to basic research and lifting R&D spending on core technologies. Despite the inevitable short-term pain this involves, there could be large long-term gains as well. After all, China has a number of advantages: a high savings rate, deep capital markets, a very large domestic market, and plenty of talented scientists and engineers. These points are illustrated in Figure 45 through Figure 48 below. In addition, China has rich experience in engaging industrial policies. That said, we believe it is equally important to overcome disadvantages like information blockages and inadequate IP protection.





"art" of policy implementation in driving innovation. First, the case for optimism about China's technological future will be clearer the more the private sector is encouraged to innovate. As discussed, the state's role in leading-edge industries not only risks damaging China's external relations but also could be a drag on efficiency. Market competition has been a driver of technological progress and global reach for an increasing number of Chinese companies and should remain so. By finessing the incentive system and leveling the playing field while supporting fundamental research, China can achieve its innovation ambitions not only through top-down policy but also via free-market dynamics. Second, government support for China-based innovation will need to be equally accessible by private and foreign companies, as outlined in the 14th FYP. An open approach to encouraging industrial upgrading would help grow the pie so that multinational corporations would also benefit.

While the objectives and agenda are clear, China may also need to perfect the

In any case, tech-decoupling should be undesirable not only for China but

also for the world. Tech sanctions, export controls, and general containment by the U.S. will certainly make it more difficult for China to innovate and grow. It is also worth noting the possibility that the U.S.'s broad actions could backfire, with considerable costs to American industries. For example, under the U.S. export controls, multinational corporations could avoid setting up semiconductor, software, or toolmaking facilities in the U.S. if China remains an important market for them. Even firms currently manufacturing in the U.S. might explore moving production and activities offshore. Companies outside the U.S. and China may have new incentives to "design out" and avoid purchasing American equipment, lest such purchases get targeted and disrupted in the future. Some other major foreign consumers of U.S. tech products may look for alternatives if they are concerned their supplies will get cut off. Targeted export controls with exceptions decided on a case-by-case basis would also create concerns over cronyism, non-transparency, and discrimination in the U.S. In short, some degree of tech-decoupling between the U.S. and China appears unavoidable, either for national security or strategic rivalry, but it is entirely possible for this process to be managed in a way that avoids inflicting unnecessary harm on all parties involved, directly and indirectly.

Over time, as China focuses on innovation and technology upgrading, it will increasingly become a competitor to industrialized economies. While R&D

intensity in economies such as South Korea, Taiwan, Japan, and the U.S. is outpacing that of China's, the absolute U.S. dollar value of spending in China continues to trump every other nation outside of the U.S. Whether China's R&D spending is productive, especially given the role of the government in allocating resources, remains to be seen. According to work by a non-government think-tank (CSET), China has become the global leader in robotics patents, accounting for 35% of global robotic patents granted between 2005 and 2019 — three times the amount granted to the U.S.²⁵ China is also making significant inroads in artificial intelligence (AI) and led the world in the number of AI patent filings in 2021 — three times the pace of the U.S. — but still significantly lags in terms of the number of AI patents granted (about 15% that of the U.S., though the gap is narrowing).²⁶

The regulatory crackdown on China's big tech firms in recent years could

jeopardize the pace of innovation. The tech regulations are motivated by different things — anti-competition, data security and data privacy laws, financial stability, or whether technology runs afoul with social objectives such as boosting family sizes or achieving "common prosperity." There is risk that such regulatory uncertainties could make it harder for private sector-driven tech firms to mobilize capital and dampen animal spirits needed to foster innovation. However, there are growing signs from the earlier Political Bureau meetings and the recent Mid-Year Politburo Meeting that we may now be approaching a more normalized regulatory regime for platform companies, as the government recognizes the economic risks involved. All that said, innovation in China has clearly not been totally stymied, as the electric vehicle (EV) sector's experience shows.

Case Study: The Rise of China's EV Sector

China now has a strong position in the electric vehicle (EV) industry, which appears to be a successful example of the country's innovation drive. The

policy push for EV development dates back to 2009. The Global Financial Crisis (GFC) and the subsequent oil price rally underscored the importance of energy security and prompted China's move to develop new energy vehicles (NEVs), mainly EVs. In 2009, the State Council unveiled a "revitalization" plan for the auto industry, which set an ambitious goal for the NEV segment: 5% of total passenger vehicle sales by 2012. In the same year, the authority launched the "Ten Cities, Thousand Vehicles" plan — namely, 10 selected cities were required to add 1,000 NEVs units that year. The plan greatly popularized EVs for public use (e.g., for taxis and buses), before expanding to 25 cities in 2010 and 88 cities in 2015 (Figure 49).

²⁵ Margarita Konaev and Sara M. Abdulla, *Trends in Robotics Patents: A Global Overview and an Assessment of Russia*, Center for Security and Emerging Technology, October 2021

²⁶ Stanford Institute for Human-Centered AI, *The Artificial Intelligence Index Report* 2022, March 2022.

Supportive fiscal policy has also been a key underpinning of China's EV

development. After listing NEVs as one of the seven strategic emerging industries for China in 2010, the government started to provide subsidies for private NEV purchases (to carmakers), first in five cities and then nationwide. The Ministry of Finance also exempted the auto purchase tax for NEVs from September 2014 to December 2017 and subsequently extended the exemption to the end of 2022. After 10 years of development, the NEV market share rose to 4.5% by 2018, leading the authorities gradually to withdraw their support. For example, the standard fiscal subsidy in 2019-20 was some 40% lower than in 2018 and was reduced by a further 20% in 2021 and 30% in 2022. Without a renewed extension, both fiscal subsidies and tax exemption will expire by the end of 2022, paving the way for a more market-oriented EV market ahead.

Figure 49. Lists of NEV-Related Policies in 2019-Present

| Stage | Date | Key Events | | | | | | |
|-----------------------------|----------|--|--|--|--|--|--|--|
| Early Development Stage | 2009 | State Council unveiled an adjustment and revitalization plan for the auto industry, with goals of achieveing 500k unit | | | | | | |
| (2009-13) | | production capacity for hybrid and plug-in hybrid vehicles by 2012 and 5% market share of New Electric Vehicle (NEV) in | | | | | | |
| | | total passenger vehicle (PV) sales. | | | | | | |
| | 2009-10 | "Ten Cities, Thousand Vehicles" NEV plan launched with selected pilot cities required to increase NEV units by 1,000 in the | | | | | | |
| | | first year. A total of 25 cities were involved in this plan. | | | | | | |
| | 2010 | State Council listed NEVs as one of seven key strategic emerging industries for China | | | | | | |
| | | The fiscal subsidy pilot for private NEV purchases started in five cities: Shanghai, Changchun, Shenzhen, Hangzhou, and | | | | | | |
| | | Hefei. After that, local governments began to unveil fiscal subsidy policies for NEV purchases. | | | | | | |
| | 2012 | The vehicle and vessel tax on NEVs and the purchase tax on NEV buses were exempted. | | | | | | |
| | | State Council unveiled the 2012-20 development plan for energy savings and NEVs, which aimed to lift plug-in hybrid EV | | | | | | |
| | | production capacity to 500k in 2015 and 2 million in 2020. The MoF provided a RMB4 billion special fund to support this | | | | | | |
| | | plan, focusing on new car models and key auto parts. | | | | | | |
| Fast Growing Stage | 2014 | The MoF announced an exemption on the purchase tax for NEVs from Sep 2014 to Dec 2017. | | | | | | |
| 2014-18) | 2014-15 | T en Cities, One Thousand Vehicles NEV plan was extended to 88 cities from the original 25. | | | | | | |
| | 2015 | In the "Made-in-China 2025" initiative, the State Council set a strategic goal to establish a complete industrial and innovation | | | | | | |
| | | system for both key auto parts and complete vehicles and to promote the development of self-owned NEV brands that are | | | | | | |
| | | competitive with global peers. | | | | | | |
| | 2017 | The exemption of the NEV purchase tax was extended to the end of 2020. | | | | | | |
| Adjustment Stage | 2019-20 | The 2019-20 fiscal subsidy standard fell by 40% from the 2018 level and the 2021 standard fell a further 20% from the 2020 | | | | | | |
| (2019-Present) | | level. | | | | | | |
| | 2020 | State Council unveiled the 2021-35 NEV development plan which aimed for NEV sales to reach 20% of new car purchases | | | | | | |
| | | in 2025, battery electric vehicles (BEVs) to be the mainstream for auto sales by 2035, and all public cars to be EVs by 2035. | | | | | | |
| | 2021 | MoF and MIIT announced the 2022 fiscal subsidy standard will fall another 30% from 2021 levels and the subsidy policy will | | | | | | |
| | | expire by the end 2022. | | | | | | |
| Source: Government reports, | Citi GPS | | | | | | | |

China's EV brands emerge strongly as the domestic market expands. EV sales

in China soared from 12,800 in 2012 to 3.5 million in 2021 (Figure 50). The EV share of auto sales rose to 13.5% in 2021 and further to 21.5% in the first half of 2022, compared with 0.1% a decade ago (Figure 51). This figure was much higher than the global average at 8.3% in 2021. To some extent, the government achieved its target for a 20% EV market share by 2025 three years in advance. Globally, China accounted for more than half of the world's EV sales from 2015 to 2021 (outside of 2020, Figure 52). In the meantime, domestic brands have risen quickly. China contributed to six out of the top 10 EV models sold in 2021 (Figure 54), accounting for 13% global sales in total. Naturally, homegrown brands dominate the domestic market, representing almost 80% of EV sales in June 2022.²⁷





Source: Wind-Economic Database, EV volumes, Citi GPS

Figure 52. China Owns the Largest EV Market in 2021



Figure 51. EV Market Share in China Reached 21.5% in 22H1, Much Higher Than the Global Average



Source: Wind-Economic Database, EV volumes, Citi GPS





²⁷ Daisuke Wakabayashi and Claire Fu, "For China's Auto Market, Electric Isn't the Future. It's the Present,' *New York Times*," September 25, 2022.



Figure 54. Amongst Top 10 EV Models Sold in 2021, 6 are From China

In addition to industrial policy, China has three big advantages that form a basis for optimism in the EV sector. The first is a huge and still growing domestic market. China accounts for more than half of global EV sales. BCG forecasts that the market share of fully-electric, battery electric vehicles (BEVs) in China could rise from 11% in 2021 to 52% in 2030 (Figure 53), outpacing the global average.²⁸ The second advantage is China's dominance of the EV battery industry. China is one of the major players in EV battery manufacturing, and four Chinese companies were among the global top 10 EV battery sellers, accounting for almost half of the global market in 2021 (Figure 55). China's technological advantage is also evident through patent applications, where it is responsible for over 90% of global lithium battery applications.²⁹ A third advantage is China's rapidly expanding infrastructure for EV battery charging. There were 1.15 million EV chargers in China as of 2021, equivalent to 65% of the global stock. The expansion of EV infrastructure has been rapid, with the number of charging piles (EV charging stations fixed on the ground) now 20 times of that in 2015 (Figure 56). However, the infrastructure is still lagging behind the demand — around a half of EV car owners are still unable to install charging piles in their communities.



²⁸ Nathan Niese et al., *Electric Cars Are Finding Their Next Gear*, BCG, June 9, 2022.
 ²⁹ Appleyard Lees, <u>Inside Green Innovation: Progress Report</u>, Accessed September 28, 2022.

Although these factors support the optimistic case, China will need to step up its push for auto chip innovation. In addition to batteries, auto chips are another core component in auto production. The semiconductor chip shortage led to an auto production cut in 2021 of over 10 million units and over three million additional cuts in the first half of 2022.³⁰ IC Insights estimates the self-sufficiency ratio for China's auto chips was less than 5% in 2021 or 10% including contributions from multinational corporations.³¹ China has a long way to go to secure its EV supply chains. In other words, the overall constraints to China becoming a fast-growing and self-reliant economy are still considerable.

Having said that, Citi Research forecasts that China will eventually overtake Europe in EV sales, with almost 50% market share by the end of the decade.

Looking at the current leading EV automakers, China is in a strong position, with the largest global market share in 2021 spread over nine companies (Figure 58). Japan looks particularly weak vis-à-vis its more dominant role in internal combustion engine vehicles, and risks losing further market share gains as China embraces the EV shift over the coming decade.

Figure 57. Chinese Automakers Gains Market Share in China at the Expense of Foreign Automakers







China's dominance of the EV market is a significant reminder that a more selfreliant China will continue to have large impacts on the rest of the world economy, either because of its growing technological sophistication or because of its continuing need for a variety of imports, or both. It is the international spillovers of China's self-reliance strategy to which we now turn.

³¹ Hana Zijian, "<u>The Localization Rate of Chinese Car Companies' Chips Is Only 5% and</u> <u>the Former Minister of Industry and Information Technology Is Angry</u>," (Chinese language), Sina Technology, March 31, 2022.

³⁰ Hans Greimel, "Toyota Cuts Production Plan Again on Chip Shortage," *Automotive News Europe*, accessed September 22, 2022.

Chapter 7. International Spillovers of Dual Circulation and Tech Nationalism

Though China's import demand for food and consumer goods will continue to deliver positive spillovers to other countries, China's industrial upgrading also has important implications: We have seen a sharp acceleration of robot installations in China in recent years. This is a boon to major industrial robot producers, largely concentrated in Japan, Germany/Switzerland, and the U.S., but a more technologically self-sufficient China is likely to have largely unwelcome implications for its trading partners.

Although the bulk of this report focuses on self-reliance becoming the mainstay of Dual Circulation, "international circulation" remains important.

When either global goods demand is strong or China's domestic demand faces challenges, China demonstrates no qualms about having exports fill the gap. Perhaps one could argue that while China wants to reduce its dependence on critical foreign inputs for its own security interests, it seems more than willing to make the world more dependent on Chinese goods, both as a byproduct of its own industrial competitiveness and as a deterrent against risk of hostile economic or financial sanctions.

Despite China's willingness to engage with the rest of the world, net direct investment flows to the country are probably in structural decline. Despite the

escalation of U.S.-China trade tensions from 2018 and the COVID-19 shock starting in 2020, average annual foreign direct investment (FDI) into China in 2019-21 ended up being 15% higher than the 2016-18 average, outperforming the rest of the world where FDI inflows were down 24% in the same period (Figure 59). This resilience highlights the importance of China's domestic market, the competitiveness of its production networks, and the stickiness of multinational corporation investment. However, aggregate FDI flows conceal a plateauing of FDI in China's manufacturing sector (at levels about 20% below the 2011 peak) and declining greenfield investments. We think manufacturing FDI may weaken as companies seek to diversify supply chains away from China due to shifting cost structure, resiliency concerns, and the rise in geopolitical risks.

Meanwhile, China has become an increasing source of regional FDI flows, with East Asia taking the largest share of China's Outward Direct Investment

(ODI). This is illustrated in Figure 60. The effects on economies, particularly in Asia, of China's shifting growth paradigm will depend on the extent to which a country's value-added contribution acts as a complement — rather than as a substitute or as a competitor — to China's evolving industrial strategy.



Figure 59. FDI Inflows Into China Have Rebounded as China's ODI Has Come Off, Leading to Higher Net FDI Figure 60. The Share of China's ODI Into Asia Has Been on the Rise

The most fundamental relationship China will continue to have with other countries is around food. Although we have argued that China is pursuing a greater degree of food self-sufficiency and is investing in agricultural productivity, it remains the case that China's overall food demand will still likely sustain current levels of imports from a number of countries that have grown to rely heavily on it as an agricultural importer, as Figure 61 shows. As China's food self-reliance is mainly in grains, countries with a large proportion of grain exports could potentially be at risk. Whether China can successfully displace import reliance — or instead, lean on those countries as a diversification strategy away from the U.S. — remains to be seen. As China seeks to support higher household incomes, the demand for meat, fish, dairy products, and fruits will inevitably grow strongly, and countries that supply those non-staples — New Zealand for dairy; Argentina, Australia, and Spain for meats; Vietnam for aquatic products; and Thailand for fruits — will likely continue to benefit from China's more affluent dietary demands.

Figure 61. Winners and Losers of China's Food Self-Sufficiency vs. Diet Upgrading in 2021



Note: Grain imports referenced the exporting country's GDP Source: UN Comtrade, Haver, Citi GPS

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China's demand for quality consumer imports will remain, although China's consumer electronics and household appliances are increasingly competitive. According to Bain & Co., China's luxury goods market has experienced remarkable growth, nearly doubling in the last two years, as a drop in international travel caused a surge in domestic luxury spending, including via e-commerce platforms and duty-free shopping in Hainan (Figure 62).³² At present, Europe, most especially France, reigns supreme as a purveyor of luxury personal goods (clothing, leather goods, cosmetics, and jewelry), and outside of jewelry brands from China and Hong Kong, much of these luxury consumer goods are largely imported.





Figure 63. ...Spurred in Part by a COVID-Related Fall in Travel Expenditure



There is also opportunity to export tradeable services to China as its per capita income rises, though regulatory hurdles remain onerous. We think

China's regulatory regime for services trade is far more restrictive than for goods trade. Within services, the trend has diverged somewhat. On the one hand, China has made inroads in liberalizing the financial sector, for example in insurance services and opening up access to capital markets. On the other hand, a Cybersecurity Law introduced in 2017 — which tightened data transfers abroad and imposed a regulatory crackdown on tech companies, including restricting user data more tightly and targeting those that run afoul with social objectives — will likely constrain foreign investment in Chinese tech giants, let alone foreign competition in local markets.

Perhaps one visible fall-out from the COVID-19 pandemic that may have some lasting effect lies in the nexus between tourism and retail imports. While some of these negative outcomes will correct when borders open, we think lower import duties, improved enforcement against counterfeit goods, deepened adoption of e-commerce (skewed towards Chinese online platforms), and low-tax shopping opportunities domestically — e.g., Hainan or Shenzhen's plans for a duty-free shopping area — could structurally shift value-added retail services domestically, at the margin. The most vulnerable economies (based on pre-COVID-19 patterns) could be Macau, Cambodia, Hong Kong, Vietnam and Thailand (Figure 65).

³² Bain & Co, *China Luxury Report 2021, January 2022.*



Figure 65. Estimated Tourism Revenues From China in Pre-Pandemic Period in 2019





Note: Tourism revenue from Chinese tourists in KH, IN, ID, PH, KR, TW, JP, VN, LK, MO are estimated using share of Chinese visitor arrivals.

Source: CEIC, Haver Analytics, Citi GPS

In addition to food and consumer goods, spillovers from China to other countries will remain positive. But China's industrial upgrading also has important implications. We have seen a sharp acceleration of robot installations in

China during the pandemic (arguably boosted by the pandemic itself), and this trend will likely persist as capabilities improve with technological advances, such as in sensors, artificial intelligence, digitally-networked production lines, and China's rapid 5G adoption rates that facilitate Industry 4.0. This will likely be a boon to major industrial robot producers, largely concentrated in Japan, Germany, Switzerland, and the U.S.³³

Figure 66. Rising Robot Installations and Robot Density in China Have Figure 67. ... In which Japan Is the Dominant Supplier by a Long Way Important Implications for Those Supplying This Technology...





³³ China's entry into the top ranking robotic companies in recent years was made possible by the hostile takeover of Germany's Kuka by Chinese appliance giant Midea in 2016, but we expect greater regulatory scrutiny from these type of deals in the future.

Source: OECD, Citi GPS

In addition, other economies can benefit as labor-intensive manufacturing increasingly finds locations other than China. Beyond rising wage costs over the last decade, a regulatory push to strengthen worker protection as well as to decarbonize industries could lead to eroding cost competitiveness in China that will hurt low-margin and low value-added businesses. Up until 2020, China has been progressively losing export market share in clothing/apparel to others, though this reversed sharply in 2020-21 (Figure 68), likely distorted by strong demand of personal protective equipment (PPE) categories of garments as well as COVID-19induced production disruptions in major garment exporters like Bangladesh and Vietnam. We expect these forces will eventually abate and reverse assuming China is able to depart from its zero-COVID approach and refocus its policies towards boosting household income. A broader look at labor-intensive manufacturing exports suggests that if China were to shift away from these industries towards higher value-added ones, the country would indirectly provide opportunities for some lower income South and Southeast Asian economies (e.g., Cambodia, Vietnam, Bangladesh, Myanmar, and Sri Lanka) and other emerging markets (e.g., Nicaragua, Tunisia, Slovakia, the Czech Republic, Portugal, and Estonia). In general, economies more likely to benefit from supply chain shifts as China's cost base rises will be those with higher degrees of export similarity (based on similar net export values in the same industries) with China, as they would already have

existing supply chains in place (Figure 69). Among major emerging market economies, the most likely biggest beneficiaries could be: Vietnam, India, Malaysia, Thailand, and Indonesia in Asia; Turkey and Poland in Eastern Europe; and Mexico in the Americas.

Figure 68. China's Share of Clothing Exports Came Off Over the Years, Despite a PPE-Related Rebound in 2020...



BD = Bangladesh, CN = China, EG = Egypt, IN = India, PK = Pakistan, LK = Sri Lanka, TR = Turkey, VN = Vietnam Source: UN Comtrade, Citi GPS

Figure 69. ...and Vietnam Is Probably the Country Best Placed to Gain From This

| | VN | TR | IT | PL | IN | TW | TH | МΧ | ID | MY | HU | GE | JP | PK | PH | KR | LK | BR | SG |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 2002 | 22 | 28 | 35 | 9 | 31 | 49 | 48 | 33 | 50 | 41 | 38 | 17 | 16 | 20 | 23 | 44 | 26 | 18 | 24 |
| 2004 | 34 | 38 | 34 | 23 | 41 | 43 | 55 | 36 | 54 | 50 | 36 | 14 | 13 | 28 | 39 | 32 | 23 | 16 | 29 |
| 2006 | 31 | 38 | 35 | 24 | 41 | 36 | 47 | 27 | 51 | 48 | 36 | 17 | 17 | 26 | 40 | 31 | 21 | 16 | 30 |
| 2010 | 30 | 41 | 32 | 23 | 34 | 33 | 42 | 28 | 34 | 38 | 33 | 17 | 17 | 26 | 32 | 29 | 20 | 14 | 15 |
| 2013 | 46 | 44 | 44 | 30 | 40 | 33 | 38 | 25 | 32 | 36 | 29 | 19 | 17 | 27 | 30 | 32 | 16 | 11 | 14 |
| 2015 | 47 | 43 | 42 | 30 | 36 | 32 | 32 | 27 | 33 | 35 | 25 | 19 | 18 | 22 | 26 | 32 | 17 | 15 | 21 |
| 2018 | 47 | 42 | 42 | 34 | 32 | 31 | 30 | 26 | 26 | 31 | 27 | 21 | 18 | 20 | 21 | 21 | 15 | 11 | 16 |
| 2021 | 45 | 44 | 41 | 39 | 34 | 30 | 28 | 28 | 28 | 27 | 26 | 23 | 20 | 19 | 19 | 17 | 12 | 11 | 9 |

Note: We use a modified export similarity index based on economies that have similarly positive net export values with China in the same industry, based on threedigit level breakdown of SITC code 7 & 8 as well as two-digit level breakdown of SITC code 6. KR, TH, VN & SG using 2020 data Source: UN Comtrade, Citi GPS

We think shifting supply chains are already altering the nature of Chinese

ODI. East Asia and Europe have seen a larger amount of Chinese ODI in recent years, and much of that increase has been in the manufacturing sector, as Chinese companies themselves start diversifying their own supply chains. To service the rapid growing Asian demand (including from China), supply chain relocation may be skewed towards ASEAN neighbors not only due to proximity but also to harness regional trade agreements, most recently the simplification of rules of origin under the Regional Comprehensive Economic Partnership (RCEP).

Yet China will continue to pursue industrial upgrading that requires more investment in intangible capital, like IT and software services. For these

reasons, the share of China's ODI in this sector has increased in more developed regions (like the EU and U.S.) in recent years, though geopolitical rivalry with the West — including the indefinite delay of the EU-China Comprehensive Agreement on Investment (CAI) and curbs on technology transfers — highlights the challenges to China's strategy of technology transfer through acquisitions. Thus, we think China's innovation strategy is shifting: Instead of piggy-backing on foreign companies, and dangling market access for technology transfers, China now wants to focus on self-reliance and a "new whole nation system" to mobilize resources for innovation and achieve breakthroughs in core technologies.³⁴

Figure 70. China's Outward-Bound Foreign Direct Investment Has Increasingly Shifted Towards Manufacturing Activity...



Figure 71. ...While Inflows of FDI Are Focused on High-Tech Manufacturing and Services



Source: Ministry of Commerce, Citi GPS

We still think China will welcome FDI, as it views multinationals having an important role in promoting China's high-tech industry. This is illustrated in Figure 71 and as described in a report by the think tank under the Ministry of

Commerce.³⁵ China will likely continue to provide policy support and incentives for multinational corporations to pursue R&D and scientific and technological innovation in China (e.g., Tesla setting up a technology innovation center in Beijing). Chinese experts also cited value for multinational corporations in the services sector, for example, in improving China's distribution network, and in developing new and marketable high quality products. They see this as helping upgrade domestic demand, something we have seen in the automobile sector.

³⁴ Citi Research, <u>China's Race to the New Tech Frontier: Innovation to Create</u> <u>Investment Opportunities</u>, June 15, 2021.

³⁵ China Academy of International Trade and Economic Cooperation, *Multinationals in China: New Opportunities Arising From a New Paradigm*, July 2021.

undeniable. This is clear from Figure 72. Other noteworthy inroads China has made and even surpassed developed economies in are AI, telecommunications technology (i.e., 5G), in EV battery supply chains, wind and solar power, and high-speed rail infrastructure. China will continue to be supportive of strategic industries relating to new emerging technologies like AI, quantum computing, Internet of Things applications, life sciences, and agricultural biological breeding, and while authorities have de-emphasized this publicly, the 10 major industries outlined in the Made in China 2025 program seven years ago are still relevant areas of focus.³⁶

We assess economies that are vulnerable to competitive challenges from China by looking at who is the largest source of Chinese imports of goods in the critical industries outlined in Made in China 2025. The results are illustrated in Figure 73. We find that if China succeeds in boosting domestic market share, this could pose challenges to Germany and Japan (in vehicles, machine tools, and robotics), South Korea and Taiwan (especially in semiconductors and other computer equipment), and to the U.S. (in agriculture machinery, aerospace, EVs, and biotech). China's attempts to develop its own indigenous semiconductor industry will be of particular focus given the industry's importance in modern electronic machineries and due to China's lingering technology gaps and vulnerabilities revealed from the export controls imposed during the U.S.-China trade tensions as well as ongoing pandemic-exacerbated chip shortages.

Figure 72. Chinese Exports Are Characterized by Increasing Levels of Skill-Intensity...

Figure 73. ...While China's Imports Are Increasingly Shaped by the Needs of Dual Circulation Economics



(% of Total) China's Dual Circulation Focus Sector Imports by Country



³⁶ Citi Research, <u>China's Race to the New Tech Frontier: Innovation to Create</u> Investment Opportunities, June 15, 2021.

China's higher self-sufficiency ratio in semiconductors would eventually hurt regional chip exporters' economic growth in the long run. In 2021, around 50%

of Asia's chip exporters economic growth the long tank in 2021, around 30% of Asia's chip exports were shipped to China and Hong Kong. (Most chip imports are re-exported to the mainland from Hong Kong.) By exporters, chip exports from South Korea (64% of its chip exports), Taiwan (62%), and Vietnam (59%) were more dependent on import demand from China and Hong Kong in 2020 (Figure 74). An important related point is that the GDP growth of Taiwan, South Korea, Singapore, and Malaysia would be more sensitive to import substitution by China, as illustrated in Figure 75. We use two proxies to estimate the chip industry's exposure to China in terms of GDP. First, we calculated the domestic value-added portion of chip exports to China (i.e., percentage of GDP) using the OECD TiVA's domestic value added share of gross exports for the industry. The latest domestic value added share of gross exports for the recomputer, electronic and optical products" industry was applied. Second, we calculated another proxy with the chip industry weight of industrial production, manufacturing industry share of GDP, and China's share of chip exports.

Figure 74. Chip Exports From South Korea (64%), Taiwan (62%) and Vietnam (59%) Were More Dependent on China and Hong Kong in 2020...

| | Semiconductor Exporter | | | | | | | | |
|-------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| | KR | TW | VN | PH | JP | MY | CN | SG | TH |
| Destination | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| China+HK | 64 | 62 | 59 | 43 | 40 | 38 | 38 | 720 | 31 |
| Taiwan | 7 | 0 | 7 | 5 | 20 | 7 | 11 | 479 | 6 |
| Singapore | 3 | 11 | 2 | 13 | 4 | 21 | 4 | 0 | 9 |
| Vietnam | 13 | 1 | 0 | 2 | 6 | 3 | 11 | 25 | 5 |
| South Korea | 0 | 7 | 2 | 3 | 7 | 4 | 12 | 72 | 3 |
| Malaysia | 1 | 4 | 1 | 3 | 6 | 0 | 5 | 332 | 5 |
| U.S. | 3 | 1 | 22 | 8 | 4 | 8 | 1 | 89 | 16 |
| Japan | 1 | 7 | 2 | 7 | 0 | 3 | 2 | 31 | 9 |
| Philippines | 3 | 2 | 0 | 0 | 2 | 1 | 1 | 35 | 4 |
| Thailand | 1 | 1 | 0 | 2 | 5 | 4 | 1 | 47 | 0 |
| Netherlands | 0 | 0 | 2 | 4 | 1 | 2 | 2 | 13 | 2 |
| Germany | 0 | 1 | 0 | 5 | 2 | 3 | 1 | 13 | 4 |
| India | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 18 | 1 |
| Brazil | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 |
| Mexico | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 18 | 1 |
| France | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 12 | 0 |

Source: UNComtrade, Citi GPS; Note: HS code 8541 and 8542 are grouped as semiconductor. SG's exports refer domestic export of STIC code 776 $\,$

Figure 75. ...And We Think GDP in Taiwan, South Korea, Singapore, and Malaysia Is Most Sensitive to China's Imports Substitution



Chip Industry Exposure to China using IP/GDP Mfg/Trade Data (% of GDP) Source: UNComtrade, OECD TiVA 2018 edition, Haver, CEIC, Citi GPS

The negative impact of China's imports substitution to the rest of the region should be mitigated by five factors. First, the U.S.'s additional technology sanctions could substantially moderate the speed with which China can catch up to other chip peers in terms of both technology and volume. Second, the substantial share of China-located chip production may still be driven in this decade by foreign companies originating from Taiwan and South Korea. Third, the supply chain shift out of China to the ASEAN region and Taiwan may continue. Regional chip exporters may benefit more from chip exports to ASEAN, not China. Fourth, for both economic and geopolitical reasons, major chip makers in Taiwan and South Korea should build additional chip production capacity in the U.S. and Europe to meet local demand for stable chip supply conditions due to both economic and geopolitical reasons. Fifth, "Chip 4" — the U.S.-led chip alliance — could strengthen overall chip supply chains amongst the U.S., Japan, South Korea, and Taiwan, although the scope and agenda of the alliance remain uncertain.

Chapter 8. Conclusion: Pessimistic or Optimistic?

The two decades since China's inclusion in the World Trade Organization have seen its economic integration with the rest of the world benefit many countries, as well as China itself. That is at risk now. It seems inevitable that a more inward-looking China is one whose economic spillovers to the rest of the world will diminish. This is particularly true for developing countries, which benefited disproportionately from the China-led commodities boom between 2001 and 2011 and from China's investment-led stimulus policies since then. That rather pessimistic conclusion will be even more true to the extent that geopolitics, rather than pure economic policy choices, drives China's inward tilt. One should not adopt too simplistic a view, however: China will obviously remain engaged with the world and will continue to trade with the world. Even in a more geopolitically-charged world China needs allies, and even the most cynical analysis would conclude that China must maintain trade relationships in an effort to preserve those alliances. But the level of trade and the level of engagement, particularly with countries that might hold more hostile trade policies towards China in the future, will likely be increasingly constrained. A more inward-looking China seems to be an irreversible trend in policymaking now.

If maximizing growth ceases to be Chinese policymakers' main economic goal, then it follows that growth is unlikely to be maximized. Security

considerations are coming to the fore in shaping economic policy choices, not just in China but in many other countries. This approach is often described as the pursuit of "supply chain resilience." Policymakers' security considerations for this goal do not always primarily involve geopolitics. In a world where transportation bottlenecks might occur more frequently, the requirements of operational security suggest that "just-in-time" production processes must more closely consider geography. Regarding China, we have argued in this report that the case for expecting a more self-reliant China is not just geopolitical, but is also partly the result of a more explicit ideological bias in Chinese policymaking. As the state becomes a more important actor in the economy, efficiency is likely to decline. Nicholas R. Lardy's book, *The State Strikes Back* (Peterson Institute, 2019) amply demonstrates that the return on assets for state-owned Chinese firms is persistently inferior to that of privately-owned firms.

Although geopolitics is likely to constrain the performance of China's economy as it turns inwards, the news is not all bad. China is certainly

experiencing increasing restrictions surrounding foreign firms' ability to do business in the country, as well as waning willingness of the world's consumers to source goods from China. The Uyghur Forced Labor Prevention Act, for example, and Europe's Corporate Sustainability Reporting Directive, both indicate that goals other than profit and efficiency are creeping into the world's economic relations with China. Companies face increasing pressure regarding the transparency of their supply chains, and operational and compliance risks could rise in China if geopolitical tensions with the U.S. or its Western allies continue to worsen. At the same time, the Asian region, in particular, remains clearly oriented towards trade. China's engagement with the Regional Comprehensive Economic Partnership is a sign that even if the world is experiencing deglobalization, a growing regionalization might end up being the most likely replacement for the kind of globalization that now seems anachronistic. All in all, China faces a number of challenges in this new world, but the country's global relevance will only keep growing. Therefore, the world will continue to pay attention to China despite its inward turn. **Citi Global Perspectives & Solutions (Citi GPS)** is designed to help our clients navigate the global economy's most demanding challenges, identify future themes and trends, and help our clients profit in a fast-changing and interconnected world. Citi GPS accesses the best elements of our global conversation and harvests the thought leadership of a wide range of senior professionals across the firm.



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Key Insights regarding the future of China's Economy

INNOVATION

Innovation in China used to take a bottom-up and market-driven approach based on its comparative advantage and international division of labor. / The tech decoupling could serve as China's Sputnik moment in innovation, forcing it to take a top-down and self-reliance approach, especially in semiconductors.



INFRASTRUCTURE

China's dependency on imported energy is rising quickly, as demand growth constantly outpaces domestic production. / Although energy security is not an immediate concern for China, new energy and new infrastructure will benefit from China's energy transition.



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POLICY

The Chinese economy has relied on external demand, or "international circulation" as a stimulus to growth by making use of its huge surplus labor to plug the economy into the international manufacturing process. / Dual circulation economics should drive a refocus on the domestic economy, with security placing higher on China's priority list.

