

JUNE 2022

Strengthening a Transnational Semiconductor Industry

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If data is the new oil, it could be said that chips are the new steel—a fundamental component of national power similar to the foundational role steel production played in the industrial age. As such, semiconductor chips are a natural focus for government intervention and support to accelerate growth and build secure supply chains. The specific goals for U.S. semiconductor policy are to increase reliability and trust in supply, reinforce all elements of chip-making capacity, and reduce China’s role in the supply chain.

Chip production is based on complex, globally distributed, specialized supply chains involving many stages in production, including specialized materials, production equipment, design and related software, fabrication, testing, and packaging. In some stages of production, labor costs are important; in others, it is capital costs because a cutting-edge fabrication plant, or fab, can cost more than \$12 billion. Taiwan, South Korea, the United States, Japan, Singapore, and China are the leading chip-producing nations. There are also important facilities (often subsidiaries of a leading producer) in Europe, Southeast Asia, South America, and Israel. This global distribution has led some to push for greater production in the United States, but trying to “reshore” a global supply chain spread across many countries would be counterproductive if the goal is a reliable and more productive supply chain. The problem is China, not global production.

The politics of the chip industry are generally favorable to the United States. One leading producer, South Korea, is a treaty ally and faces less risk of disruption from China than does Taiwan. Another leading producer, Japan, is one of the most important U.S. security partners and, with the United States, dominates the production of semiconductor manufacturing equipment (SME). ASML, another leading producer of SME, based in the Netherlands, is also an important ally. Singapore, while it would prefer not to be caught in a battle between giants, is also a dependable partner. These countries share democratic values and in many instances are treaty allies. The global distribution of chip-making in countries friendly to the United States is an advantage.

The many segments in the semiconductor supply chain—from materials to design, fabrication, packaging, and testing—create opportunities for multinational cooperation. Not all segments need to be located in

the same country. Striving for self-sufficiency in the United States or Europe will impose serious efficiency costs and forego a key advantage over China: partnerships already built on a strong commercial foundation and shared political values based on the rule of law and democracy.

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Reshoring also runs counter to a fundamental change in how chips are made—the success of the “fabless and foundry” production model. Fabless means a company designs and markets chips but contracts their production to a third party. The foundry bears the financial burden of maintaining state-of-the-art fabs. This is a commercially viable alternative used by many leading tech companies.

Taiwan Semiconductor Manufacturing Company, or TSMC, has a 50 percent share in the foundry market. However, TSMC’s proximity to China, which has routinely threatened to invade and absorb Taiwan, creates a potential security risk. The greatest geopolitical vulnerability in this global industry is Taiwan. Taiwan, after decades of investment, dominates the production of the most advanced chips but faces greater risk from an increasingly belligerent China that routinely threatens to occupy it. Its proximity to China contributes to uncertainty, but even if China was friendly, letting a single nation achieve such a dominant role in a key industry may not make strategic or commercial sense.

Whether these Chinese threats are credible or not, they are recurrent, so much of the focus of U.S. policy has been to expand production capabilities outside of countries in close proximity to China—and some would like these to relocate to the United States itself. China’s threat and the onset of a chip “shortage” has led U.S. policymakers to consider how to strengthen this strategic industry. Discussion has tended to blur the distinction between the need to reduce reliance on China and Taiwan with reducing reliance on a global supply chain. In fact, the issues are slowing China’s growth while ensuring the United States and its allies have access to the chips they need. The United States has a fundamental decision to make on how much to rely on a transnational supply chain for chips rather than on indigenous production. This paper argues that the transnational approach—working with Japan, South Korea, Europe, and other partners—is by far the best path.

There is a risk that in the pursuit of a reliable supply chain, the United States will seek to build a national chip production base rather than follow the model used by successful chip companies—a model that spreads design, fabrication, and other production segments around the world. Intel, for example, has manufacturing facilities in China, Malaysia, Costa Rica, Israel, and Ireland. While there are concerns that the United States will not be able to “[securely buy them \[chips\] at will from other nations](#),” it is difficult to envision a scenario where Ireland, Costa Rica, or Israel decide to embargo the United States. It is important to be precise: the problem is China, its industrial policies, and its intentions regarding Taiwan, not offshore production.

Europe also has a fundamental decision to make on technological sovereignty and autonomy. This decision will determine whether Europe will catch up or decline in technology. The key question for Europe is partnership with the United States. It is in the United States’ interest to see a technologically strong Europe. It will harm the United States’ interests if Europe pursues autonomy and becomes

weaker, but it will harm Europe's interests more. Strategic autonomy has been the dream of some in Europe since de Gaulle, but it remains unrealistic. In building a closer partnership among democracies on technology, shared concerns about supply chain vulnerabilities make semiconductors a good candidate for increased cooperation.

China Reshapes the Global Chip Market

China is the center of the chip issue. Building a resilient and trustworthy international technology supply chain means a reduced role for China, given its predatory practices and the political risks of doing business with China under Xi Jinping. Doing this requires shrinking the market for Chinese suppliers, reducing the transfer of advanced chip technology (by not only using export controls but restricting Chinese investment), and limiting Chinese participation in research and development (R&D).

Chinese policymakers have sought since the 1980s to build indigenous chip-making capabilities. They did this by providing ample financial support to Chinese companies, buttressed by industrial espionage and predatory business practices. If China competed fairly and if its goals were commercial instead of political, countries would accept this new competition. China's chip effort, however, is distorted by its strategic goal to displace Western suppliers as part of its pursuit of a restructured global order that gives China dominance. China's continued investments will increase its capacity and market share in the next decades regardless of U.S. and Japanese policy, but decisions by these countries (and the European Union) to continue to restrict Chinese access to chip technology can significantly slow this increase. While China's goals are to build an indigenous supply chain and displace Western suppliers, Chinese experts admit privately that it will take more than a decade before they reach parity with Western chip suppliers.

The issue for supply chain resilience is the gravitational pull of the Chinese market. Companies in the United States and Europe enjoyed the heyday of globalization and would prefer to continue to invest in and sell to China. China is a leading global consumer of Western technology, including semiconductors (albeit often for products made to be reexported). As a result of its plans to build a dominant indigenous chip industry, China is also the leading market for SME. China's chip industry must also acquire know-how, the intangible skills needed to produce chips at scale, by acquiring Western companies or by hiring Western engineers (and it is making a concerted effort in Taiwan to do this).

China has reacted to Western export restrictions by creating a "[cross-border semiconductor work committee](#)" to entice Western companies to invest in China (this may also be China's response to the many national chip initiatives in other countries). The committee continues China's long-standing policy of extracting technology from the West. Judging from past Chinese practice, this will include using coercive measures and incentives to extract technology. The Chinese effort faces serious obstacles from increasing export control restrictions in the West that block chip technology acquisition by China.

Decisions on what can safely be transferred to China will shape the chip market for years. The argument from industry is that continued sales to China provide the revenue needed to support their R&D. There is some truth to this, and governments are not prepared to compensate companies for the loss of sales to China. However, the industry view can also discount security concerns and the longer-term competitive damage of continued sales to China.

The alternative view, that the United States needs to move quickly to cut all chip and chip-related exports to China, makes even less sense. This would do immense damage to American companies. A good case can be made that it is in the United States' interest to let Western companies continue to sell to China when the exports do not create an unacceptable risk. Commodity chips (those sold in the millions and

not designed for specialized purposes) are low risk; SME is high risk. A policy that balances risk and opportunity will need to weigh the long-term security risks against the near-term benefits of continued revenue. This is not just a problem for the United States. Without restrictions by Europe, the United States, and Japan on exports to and acquisitions by China, efforts to rebuild a resilient chip industry will be pointless. This is particularly true for Europe, whose chip industry is least able to compete with China.

Unchecked, China will seek to do to the semiconductor industry what it did to 4G telecom suppliers, using a blend of subsidies, predatory trade practices, and espionage to drive foreign competitors from the market. For semiconductors, this effort has been slowed by the Western reaction, which includes restrictions on Chinese acquisition of Western semiconductor companies and export restrictions on semiconductor-related technology. Blocking China cannot be the sole focus of policy because, at best, Western restrictions can only slow China, not stop it. Restrictions may give the West a decade at best. The goal should be to strengthen the Western semiconductor industry and build a new transnational chip supply chain independent of Chinese suppliers.

Demand, Supply, and Autonomy

China's market distortions are only one of the problems facing the chip industry. The other is that the world is at the limits of chip production capacity. The ongoing shortage of semiconductors shows how essential they have become for the global economy. Demand has grown more than 10 percent annually, and there was a more 20 percent surge in demand as a result of the Covid-19 pandemic. This has led to a number of initiatives—such as the Creating Helpful Incentives to Produce Semiconductors (CHIPS) for America Act in the United States; the European Chips Act; and [new programs](#) in Japan, Singapore, Taiwan, and South Korea—to expand supply and reinforce the chip supply chain. These initiatives include government support for R&D and workforce development; subsidies to reduce the cost of new facilities; and supportive trade, tax, and investment policies.

The problem is that servicing a global market that included China has led to strategically risky concentrations. Asian companies fabricate 75 percent of the global semiconductor supply. The semiconductor industry is centered around the Pacific Rim, giving the United States and Japan advantages as they strengthen their chip industries. Europe's chip industry shrank as Asia's grew and as manufacturing moved to China. This means that transatlantic partnership in chips is more important for Europe than for the United States, but the goal for policy should be to create a triumvirate of major chip producers—Japan, the United States, and the European Union—who form the core of supplier nations.

Each of these three has strengths and weaknesses. Japan faces problems that are similar to those seen in the United States. Japan's share of chip production declined to 10 percent in the last 30 years. According to interviews with Japanese officials, Japanese companies did not modernize their fabs. However, the country remains strong in other chip-making sectors like SME and materials. Japan's partnership with the United States to restrict transfer of SME to China will significantly slow China's chip industry growth. Japan is relatively better positioned than Europe to regain a greater degree of sufficiency in chips, given its tech giants, position in robotics, and its new policies to grow its semiconductor industry. Japan has committed to subsidies for chip-making (including for 5G infrastructure). Like the United States and Europe, Japan is also offering subsidies to foreign suppliers like TSMC to build in Japan.

Europe has strong capabilities in the research, design, and (with ASML) production of advanced

manufacturing equipment. Europe is also strong in the production of earlier generations and specialized chips, such as those for automobiles, which do not need to be at the cutting edge of chip technology. However, Europe, like the United States and others, has been entranced with acquiring cutting-edge fabs, the most expensive and difficult element of chip production. Increasing EU market share is a sensible goal, but it may be best achieved by expanding in those segments of the chip supply chain where the European Union is already strong, or where there would be a security advantage in replacing Chinese firms (or Western firms located in China), such as in testing and packaging.

The three leading chip companies are TSMC, Samsung, and Intel. One question is whether Brussels can be content without adding a European company to this list of giants. But adding a chip company is easier said than done. China, after spending tens of billions of dollars for more than a decade and using illegal practices to gain advantage, could only produce a few companies that were on a path to becoming a major player (Semiconductor Manufacturing International Corporation and perhaps Yangtze Memory Technologies Company). But both were dependent on Western technology, so export controls and sanctions have seriously slowed their growth. For the most advanced chips (by feature size and performance), Chinese companies are unable to produce reliably at scale. This will take years to change, a period now made longer by sanctions.

Not all chips need to be at the cutting edge, however, and there is a broad market for microelectronics (such as transistors or converters), older generation “legacy” chips, and specialized industrial chips. Europe already has a strong presence in these sectors. A study by a leading United States chipmaker found that three-quarters of the chips in mobile phones are from an older generation. Some of the legacy chips and many of the microelectronic components in smartphones now come from China. The European Union would be better served by expanding capacity in these markets. A strong case can be made for the economic and political advantages of a transatlantic approach, in cooperation with Japan, to rebuilding the chip supply chain with a greatly reduced role for China, but the European Union will need to change its investment priorities to support this.

The European share of the global semiconductor industry could be increased if activities like testing and packaging are moved from China to lower-cost countries in Eastern Europe. U.S. tech companies are already investing in Europe, with Apple and Intel making major investments in semiconductor-related ventures. Europe could also expand on its strengths in research if the goal is market share rather than a completely indigenous supply chain.

For Europe, fabless chip production can take advantage of the European strength in R&D. Arm, the UK chip design company, is the global leader and a case in point, but there are also world-leading design and research capabilities in Germany and Belgium. Pursuing a vertically integrated (i.e., all production segments) chip capacity will be expensive and time-consuming. An approach that takes advantage of specialization and segmentation in chip production and builds on a fabless approach promises quicker growth in market share and capability while aligning with U.S. and Japanese goals to reduce reliance on China.

Industrial Policy

Industrial policy was once considered taboo, but geopolitics makes it necessary again. The issue is how to design policies that are effective, take globalization into account, and build on Western strengths. Industrial policy requires government investment in industry and research, building institutions for cooperation with the private sector and with other governments, and a willingness to create national champions.

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An example of old-school industrial policy would be for a government to identify a need—say for airplanes, design, or the commission of airplane design—and then build plants to produce those planes (in this example), either managing the plants itself or contracting the management to a private company. This contractor need not be a company specializing in the product in question—in World War II, heavy industry manufacturers like auto or washing machine makers were pressed into service to make planes, engines, and other munitions. For example, in the 1930s, the U.S. Army identified the need for a long-range bomber, wrote a 17-page specification, and then held a competition among aircraft manufacturers (the winner was Boeing and the B-17). This is still—in modified form—the model used in defense contracting.

The lesson of the B-17 is that industrial policy has two essential components: generous government spending and the creation and acceptance of national champions. Some government-directed coordination of industry (as with the creation of SEMATECH in the 1980s) can also help. Without these, the chance of a successful industrial policy declines. Both have difficulty for the United States, which has been parsimonious for decades (one reason chip fabrication has declined here) and reluctant to minimize anti-trust concern. Parsimony and antitrust are, however, luxuries the United States cannot afford in a conflict with China.

For one industrial policy for semiconductors, the government could identify the type of chip it needs, set performance requirements, and award contracts. No country does this today. Secretary of Defense William Perry found 30 years ago that the Department of Defense could get better and cheaper chips from the commercial market than those made especially for the Pentagon. A very small number of highly specialized chips for sensitive national security purposes (like nuclear weapons) may need to still be designed by government labs and even produced there, but none of these chips are cutting-edge. Upgrading the fabs that now make them would cost tens of billions and would not provide for innovation or scalability in production.

Other approaches to industrial policy could provide direct payments, low-cost or no-cost loans, or reduced taxes to the desired industry. China uses these techniques and they can be usefully mimicked. A third approach would be to lower the cost of inputs for production, such as by subsidizing R&D or needed infrastructure. This allows for a greater reliance on competition, which drives efficiency and innovation in ways that direct government subsidies to specific companies can undercut. Each approach can be used in combination and move the market in a direction desired by policymakers. In today's international environment, such policies are more likely to succeed if they are collaborative and integrated into an international market.

Chips are part of a competition among economic models. China has found a way to (imperfectly) combine market forces and government direction to guide investment (whether Xi's political clampdown damages China's investment and innovation model remains to be seen). The Chinese Communist Party has agreed on industrial targets (like building a chip industry) and is willing to spend consistently for decades at levels democracies are unwilling to match. Head-to-head competition spending would be unwise. In any response to security concerns or the chip shortage, repeating China's government-directed efforts

to expand its national semiconductor industry would be unwise. This has squandered billions of dollars because state programs in China often subsidize inefficiency. The United States should not do the same—not just because it is a waste of resources, but also because it is politically unsustainable in democracies.

The issue is not just how to reinforce or accelerate the commercial production of semiconductors. If the United States is vulnerable, it is not in chips but in microelectronics at large. Over the last decades, manufacturing of them has shifted out of the United States and Europe to lower-cost producers in China. These are basic components, such as transistors, capacitors, or converters, which are neither sophisticated nor expensive—the margins on microelectronics are low. If China cannot make digital goods without U.S. semiconductors, the United States cannot make digital goods without microelectronics from China. An industrial policy among allies and partners could usefully focus on rebuilding microelectronic capacity and other segments of the chip industry, such as testing and packaging, rather than on the more glamorous fabs.

Shortages, Gluts, and Subsidy “Races”

Most major chip-producing nations already subsidize chip manufacturing. There has been a subsidy “race” for years as countries compete to recruit chip manufacturers to their territory. An Organization for Economic Cooperation and Development [study](#) found that 10 out of 11 countries with major chip industries used some form of subsidies. The effect is telling. The United States has consistently [held](#) around 50 percent of the global chip market, but its share of chip fabrication has declined steadily to about 11 percent. One reason for this is that the United States (at the federal level) has not used subsidies, in contrast to other chip-producing nations. The CHIPS for America Act and the related Facilitating American-Built Semiconductors (FABS) Act could change this by providing federal subsidies to locate production in the United States.

Ending the chip shortage cannot be the focus of policymaking. Because it takes three to four years (and many billions of dollars) to bring new chip fabrication capacity online, the [shortage will be over before new facilities](#) can have an effect. The chip shortage highlights problems with the “old” supply chain, which included China and was based on “just-in-time” sourcing. It also points to weaknesses in economic prediction. Car companies accepted reports that the pandemic would lead to a prolonged economic reversal. In fact, those who pointed to a “V-shaped” recovery were right. At the start of the pandemic, car companies canceled chip orders and their place in the queue was often taken by manufacturers of digital consumer devices, where demand is surging. Some chip makers who supplied the car industry retooled for other markets. The demand for chips in 2021 increased by 26 percent as fears of a pandemic recession receded, exceeding the capacity of existing suppliers. Unsurprisingly, the response has been to call for increased production and investment.

The long-term growth in demand for chips means that any “glut” created by overinvestment in production or subsidies will be temporary. The growth in demand is tied to the continued digitization of economic activity, which is very unlikely to stop. Overinvestment would be a short-term phenomenon and is still more efficient than centrally directed investment. Leading chip companies already say they plan to increase investment by 50 percent over [2019 levels](#). China is also planning massive investments, and one policy issue is how to accommodate new Chinese chip production in the global market—China will be in the market whether we like it or not, making subsidies crucial for competition and the creation of rules for competition and countering China’s predatory trade practices a central requirement for policy.

The primary cost for increased chip production is the cost of capital, including human capital. One reason Europe's share of chip production declined dramatically reflects higher labor costs compared to China and others. The "supply" of capital depends on the global capital market and interest rates, while human capital depends on investments in R&D and education. Governments can shift the cost curve for chip companies in ways that increase supply and resilience through monetary policy (although the current "easy money" era is coming to an end); through targeted incentives in taxes, R&D, infrastructure, and STEM education; and through supportive trade and intellectual property policies. If subsidies can reinforce private investment, the fundamental effect will be to shift the location of production as well as expand it.

Most countries that provide subsidies are content with conditioning support on location, since this creates jobs, tax revenues, and increased market share. Congress should resist the temptation to attach conditions to the funding that are not directly related to increasing the supply of chips because this will be counterproductive in a global competition.

Building Cooperative Structures

The overarching interest in seeing a strong technological and economic partnership among democracies requires creating a policy superstructure to reinforce market decisions. The creation of the EU-U.S. Trade and Technology Council, though it has only begun its work, provides a useful mechanism for reaching an agreement on policy, but there are tensions between the potential benefits of cooperation and a desire for autonomy that will need to be pragmatically addressed. The Quad (Australia, India, Japan, and the United States) offers another opportunity for cooperation and coordination of policy goals.

Effective policy should resist the temptation to pursue autarkic self-reliance and instead reinforce a multinational approach to strengthening chip-making in democracies. When measured by cost and performance, market-based transnational supply chains—based on company specialization—are more efficient and innovative than national supply chains. This multinational approach provides an innate advantage over China. A trustworthy and economically viable transnational supply chain will need to extend beyond the United States and include Mexico, Canada, Australia, South Korea, Taiwan, Singapore, the European Union, and most importantly, Japan. It should use competition among firms to achieve efficiency. For some digital technologies like artificial intelligence, guiding principles and rules will be necessary to ensure responsible development, but this is not important for semiconductors. In all cases, policy should avoid a centrally directed approach that invests in a fully indigenous industry. This is a greater danger than a "subsidy race."

Some previous efforts to create transnational supply chains using government subsidies ran into difficulties in managing the dynamics of competition. An effort to create a transatlantic defense industrial base ran into opposition on both sides of the Atlantic because of the interest in preserving company and national advantage. Companies naturally prefer that any subsidies favor national participants, but in a globally distributed industry, this can be counterproductive and in the European Union, this can mean a discussion among all 27 member states over the allocation of support.

Parochial concerns are understandable but do not often lead to the best economic outcomes. Instead, cooperation in expanding the provision of the public goods required by the semiconductor industry, including research, workforce, infrastructure, the "soft infrastructure" of intellectual property protections, and financial systems to guide investments, can reduce the cost of inputs in chip-making and reinforce market-driven investment decisions. These are the areas for government action and cooperation between the United

States and its allies. This kind of cooperation would allow the West to cooperate strategically at the same time as its companies compete.

China is unlikely to change course in its international goals or industrial strategies. This will create unusual market dynamics that do not fit neatly into national policy boxes. China will build a bigger chip industry to serve its domestic market and global customers and will continue its attempts to move up the chip “value chain.” Sellers will want access to the Chinese domestic market. Chip customers globally will prefer low costs, taking into account political risk and trustworthiness. One key decision is how to accommodate Chinese demand without damaging security, since there is no black or white answer to this. The result of these political dynamics will be two loosely connected supply chains competing for the same markets.

Democratic governments have fundamental political decisions to make on how to cooperate and take advantage of a transnational supply chain. There will be challenges in designing such policies, but successful cooperation will leave democracies richer and stronger in the current contest. ■

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A shorter version of this paper was originally drafted as part of the Center for a New American Security project “[Developing a Transatlantic Technology Strategy](#).”

This report is made possible by general support to CSIS. No direct sponsorship contributed to this report.

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