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Contents

Executive Summary

As the international debate over the use of industrial policies intensifies, reliable data are more important than ever. This project aims to quantify the size of total industrial policy spending in China and compare it to other economies. Much of the existing research on industrial policy focuses on its effects, but there are few, if any, published studies that attempt a systematic comparison and quantification of overall industrial policy spending. This project does not seek to assess whether industrial policies are helpful or harmful. Instead, the primary goal is to demonstrate what estimations are possible given available data and identify areas for more reporting or research.

Measuring industrial policy spending is challenging. First, the definition of "industrial policy" is contested. Second, data are difficult to acquire and reported inconsistently across economies; this is especially a problem when it comes to China. Third, many instruments of industrial policy are unquantifiable. To address these challenges, this study uses a distinct methodology that is conservative in its approach, especially regarding its estimates of China's industrial policy spending. The methodology in this study excludes unquantifiable instruments of industrial policy and may underestimate measures where data are unavailable or incomplete. Therefore, total industrial policy spending in China may be significantly higher.

To put China's industrial policy spending in perspective, this study also analyzes the following economies: Brazil, France, Germany, Japan, South Korea, Taiwan, and the United States. The study compares spending in these economies during 2019 and not more recent years because of data limitations and concerns about large distortions from pandemic-related policies. To guard against the potential distinctiveness of any individual year, spending for China is estimated from 2017 to 2019.

The data collected for this report yield three core findings:

- Even using a conservative methodology, China's industrial policy spending is enormous, totaling at least 1.73 percent of GDP in 2019. This is equivalent to more than $248 billion at nominal exchange rates and $407 billion at purchasing power parity exchange rates. This is higher than China's defense spending for 2019, which the Stockholm International Peace Research Institute (SIPRI) estimated at $240 billion at nominal exchange rates.[1] Alternative data and assumptions, including for China's below-market credit, subsidies to non-listed private firms, government guidance funds, and state-owned enterprise net payables, would result in larger aggregate estimates.
- Even with such a low-end estimate, China is an outlier; it spends far more on supporting its industries than any other economy in this study. As a share of GDP, China spends over twice as much as South Korea, which is the second-largest relative spender in the sample. In dollar terms, China spends more than twice as much as the United States.
- From a historical perspective, China's approach to industrial policy is exceptional, as Beijing is sustaining or increasing vertical industrial policy at a level of development when other economies have dialed back. Three industry case studies—aluminum, semiconductors, and electric vehicles—show how China stands out in terms of both quantifiable spending as well as non-quantifiable policy tools.

This exercise yields several important policy implications. Greater transparency and more harmonized reporting about industrial policy spending is vital. Governments and international institutions that govern economic activity need to broaden the scope of tools they use to calculate the total value of industrial policy. It is also important to require governments to consistently provide more comprehensive and detailed data about the ways in which they support their companies and industries.

The report takes no position on how data on industrial policy spending should be utilized. There are strengths and weaknesses to using data to shape policy at various levels of governance (from unilateral to multilateral) and with different levels of constraining authority (e.g., as a source of transparency or as a tool for imposing penalties). Policymakers need to determine how best to employ this new information, keeping in mind the potential trade-offs between speed, legitimacy, and effectiveness when responding to China and other countries' industrial policies.

1

Resetting the Debate on Industrial Policy Spending

Tackling Structural Issues: The Need for Data

One of the greatest challenges of U.S. foreign economic policy is figuring out how to effectively deal with the negative consequences of China's state capitalist system. For much of the past 40 years, Washington has pursued a two-part strategy. The first element has been to encourage China's marketization and integration into the global economy. The second has been to use bilateral negotiations and the rules of the World Trade Organization (WTO) to discipline China's behavior when the country does not meet its obligations.

Engagement has yielded mixed results for American businesses, workers, and consumers. U.S. exports have risen dramatically, investment in China has generated sales there and made global supply chains more efficient, new employment opportunities in certain sectors have been created, and consumers have had access to less expensive products. At the same time, China's interventionism has harmed U.S. economic interests, with deprived sales, lost intellectual property, technology lock-in, market volatility, displaced workers, and, in some cases, counterfeit or defective goods.

To address the downsides of commercial connectivity, U.S. governments of both political parties have primarily taken a case-by-case approach. This ad hoc strategy has involved identifying individual violations by Chinese companies and violations embodied in China's regulations or their implementation. This trench warfare has resulted in occasional successes, getting China's central authorities and local governments to remove many restrictions that limit opportunities and harm U.S. economic interests.

However, over the last few years, a consensus has emerged in the U.S. policy community that a piecemeal approach is of decreasing utility. Bilateral negotiations and WTO cases take a long time,

and issues are often only addressed after substantial harm has occurred. Moreover, China adopts restrictions that are harmful but not outright violations of its express commitments. For example, China is still not a signatory to the WTO's Agreement on Government Procurement, and the WTO only superficially covers some kinds of industrial policy, such as implicit financial support, that do not involve explicit trade-related restrictions. As a result, there is a sense that the only way to effectively proceed is to address the underlying distortions embedded in China's overall system.

The Trump administration's Section 301 trade investigation of China, completed in March 2018, originally operated in this vein, with an aim of resolving a range of structural policies and common practices that weaken the protection of intellectual property.[1] But the 2020 Phase One agreement fell short of its original goals; it included a range of specific adjustments to intellectual property policy, some market concessions, and a set of targets for U.S. exports without requiring substantial constraints on systemic features of China's underlying political economy that make these problems endemic. At the time, the Trump administration announced that the Phase One agreement would not cover "structural issues," which it hoped would be taken up in Phase Two negotiations. The Biden administration has criticized the Trump administration's bilateralism, but it has continued to highlight the underlying challenge of structural issues as opposed to individual restrictions.

Further progress—whether unilaterally, bilaterally, or multilaterally—is hindered by a basic problem: a lack of data. All the information that currently exists is piecemeal and partial. It is possible to identify specific Chinese policies that support domestic firms and industries and, on occasion, determine their scope and consequences. Some experts have tried to calculate the value of these measures, but all have offered only partial views. Hence, there still is no overall picture of state support for industry. And without a clearer sense of the true size and scope of state support, it is difficult to pursue any kind of comprehensive policy response.

The Goal

This study aims to move the scholarly and policy conversations forward by shifting away from micro analyses toward a more macro view of state support. To do so, this project sets the goal of doing enough research and math to be able to write a sentence along the following lines: "Total industrial policy spending by China is $X billion per year, or equivalent to Y percent of China's gross domestic product (GDP)." Doing this math involves pulling together data about many types of state support, from standard fiscal subsidies to tax breaks to discrete uses of financial credit.

Moreover, because the policy of the United States and others toward China, as well as the view of how to best establish and implement the rules of the international economy, depends on how similar or different China is from other countries, this project also aims to produce the following sentence: "China's industrial policy spending is less than/equal to/or greater than that of other economies." Hence, this report not only calculates total industrial policy spending for China; it also makes the same effort for seven other economies: Brazil, France, Germany, Japan, South Korea, Taiwan, and the United States. There is enough variation among these cases to give an initial, general picture of the degree to which Chinese state spending is distinctive.

There has been little progress on the macro picture largely because obtaining the necessary data is difficult. Governments are not transparent about the tools and scale of industrial policy, and some elements of state

support are inherently difficult to quantify. Also, there is no universally accepted definition of industrial policy. This project treats this problem as an enticing opportunity that must be grasped.

Although this study was originally motivated by trying to understand the extent of Chinese state support for industry, it tries to take a dispassionate and balanced approach toward understanding this problem in a global context. It also is important to highlight what this study does not aim to do. It does not make any judgment about whether any of the tools it analyzes, for China or other countries, are permitted by domestic laws, bilateral agreements, or international conventions. Likewise, this study avoids making any claim about whether these measures are economically helpful or distortive. And finally, this study does not explicitly advocate for any specific policies to tackle the challenge of industrial policy from China or any other economy. Instead, the project's goal is more basic: to simply identify industrial policy tools and calculate their values. Doing so is essential for effectively moving forward on shaping appropriate policy responses.

In addition to contributing more analysis to the debate on industrial policy, this report aims to shine a light onto the gaps in the available data and provide opportunities for future research and international efforts to improve transparency.

The remainder of this chapter outlines the project's definition of industrial policy, which helps further delineate the boundaries of this study; provides a thumbnail sketch of how analysts have thought about industrial policy in both scholarly and policy contexts; and sketches out the structure of the report.

What Is Industrial Policy?

There is no consensus on what counts as industrial policy. Despite a resurgence in interest in the topic, scholarly definitions vary significantly.[2] What to include or exclude as industrial policy is often a point of contention among those arguing about the successes or failures of such policies, with proponents favoring broader definitions and critics favoring narrower ones.[3]

Broader definitions cover any government intervention or policy that affects the competitiveness of an economy's firms or industries. This includes horizontal "untargeted" policies, which are typically available to all firms irrespective of their sector or location. Examples of horizontal policies are measures to improve the business climate, build infrastructure, strengthen research institutions, or increase opportunities for small firms.

Narrower definitions focus on government interventions that aim to alter the sectoral structure of the economy. Typically, such definitions emphasize vertical, or targeted, policies for specific firms, sectors, or locations. The distinction between horizontal and vertical policies is not always clear in practice. Some policies—such as research and development (R&D) tax credits or government procurement rules—might be open to all firms in theory but in practice will disproportionately benefit firms in certain sectors or of a certain size.

Industrial policies can potentially utilize many different instruments. One way to categorize them is by their policy domains or the market segments they affect. Another is by the channels through which they affect firms, for example, whether they use market-based mechanisms or direct state interventions (see Table 1.1).[4] Alternatively, policy instruments are often distinguished by whether they affect the supply of or demand for goods, firms, or sectors. With such complexity, economists

continue to propose new taxonomies for industrial policies. For example, a recent study by the Organization for Economic Cooperation and Development (OECD) suggests further categorizing supply-side instruments based on whether they affect individual firm performance ("within" measures) or industry dynamics ("between" measures).[5]

Industrial policies can be explicit or implicit, ranging from direct subsidies to unofficial political guidance. Advanced economies are typically more transparent about their instruments, which are often disclosed in budgets or reports from state-affiliated entities. Despite the significant gaps in reporting standards, OECD member countries are more forthcoming when it comes to budgets and expenditure reporting.

Economies with less state capacity or less transparent bureaucracies have historically relied more on implicit or informal mechanisms, such as administrative guidance to firms or banks or local discretion in courting foreign investment. The nature of such instruments has implications for their quantifiability, as discussed later in this report.

Table 1.1: Industrial Policy Instruments

Policy Domain	Instruments	
	Market-Based	Public Goods / Direct Provision
Product Market	▪ Import tariffs ▪ Export subsidies ▪ Tax credits ▪ Investment/FDI incentives	▪ Government procurement ▪ Product standards ▪ Localization requirements ▪ Product subsidies, tax incentives ▪ Investment promotion agencies, trade fairs
Labor Market	▪ Wage tax credits, subsidies ▪ Training grants	▪ Training institutes ▪ Skills councils
Capital Market	▪ Directed credit ▪ Interest rate subsidies ▪ Loan guarantees	▪ Development bank lending ▪ State investment funds ▪ Export credit agencies
Land Market	▪ Subsidized rent ▪ Below-market sales	▪ Infrastructure ▪ Special economic zones ▪ Incubator programs
Technology	▪ R&D subsidies, grants, finance coordination	▪ Support for technology transfers ▪ Public-private research consortia ▪ Public research institutes

Source: Adapted from John Weiss, "Taxonomy of Industrial Policy," United Nations Industrial Development Organization, 2015, Inclusive and Sustainable Industrial Development Working Paper Series, Working Paper 8, https://www.unido.org/api/opentext/documents/download/9925558/unido-file-9925558.

The objectives of industrial policy have not been constant. Traditionally, the commercial competitiveness of domestic firms and industries, which helps drive economic development and

growth, was seen as the dominant objective. More recently, the goals of industrial policy have expanded to include the environment, innovation, social or regional inclusivity, supply chain resiliency, and national security.[6] Some states have political preferences for pursuing policies that alter the productive or ownership structure of the economy, such as favoring state-owned enterprises. These goals are often not mutually exclusive, even if in many instances they end up being hard to achieve simultaneously.

In this project, industrial policy is defined as any state intervention—whether explicit or implicit—that aims to reallocate resources to support certain firms or sectors to achieve one or more policy objectives. This definition is narrow in the sense that it excludes most "horizontal" policies, which are meant to help strengthen an economy's fundamental foundations and the overall competitiveness of business. But the definition is broad enough to allow for multiple motivations and instruments, ranging from direct subsidies to support through the credit system and other innovative tools.

This study adopts a pragmatic approach guided by available data and comparability across countries. As noted above, because the focus is on targeted support, investments in infrastructure and education as well as agricultural subsidies are excluded from the definition. The selection of tools and the analytical methodology will be discussed in more detail in the next chapters.

Evolving Policies and Scholarly Literature

Global perceptions of industrial policy have gone through cycles since the second half of the twentieth century. Until the 1970s, many governments treated industrial policy as a legitimate development strategy. In Latin America, many governments pursued import substitution as a path to industrialization, while states in Western Europe set up development agencies and banks and supported national champions in critical sectors.[7] The oil shocks and economic stagflation of the 1970s led to a retrenchment of state resources and a rethink of industrial policy. Popular narratives of economic growth switched from an emphasis on economic structures to structural reforms. During the 1980s and 1990s, the "Washington Consensus" view in favor of market liberalization and against state interventions prevailed in many governments.[8]

In the past two decades, however, China's rise, the global financial crisis, and climate change have spurred renewed interest in industrial policy. Most recently, tensions between China and the West, the Covid-19 pandemic, and Russia's invasion of Ukraine have added new urgency to the debate. These cycles of narratives and events have coincided with changes in industrial policy strategies and goals.

Research on industrial policy has often tracked these cycles. As industrial policy fell out of favor among policymakers in the 1980s and 1990s, research into the topic declined as well. The exception was research on the role of the state in engineering the apparent "economic miracles" of East Asian economies, including Japan, South Korea, Taiwan, and Singapore.[9] This debate has extended to China's experience, which in some ways mirrors that of the "Asian Tigers" of previous generations but differs in others.[10]

Much of the industrial policy literature has focused on assessing policy effectiveness, including in advanced economies.[11] Another strand of recent research focuses on identifying the distortions in trade that derive from industrial policy.[12] The OECD has produced a series of reports on subsidies that focus on trade distortions in specific sectors, such as semiconductors.[13] Others have inventoried corporate subsidies in China, the European Union, and the United States.[14] Recently, some have advocated for industrial policy in advanced economies, including for the United States in response to

China or climate change.[15] Others have warned about the risks of industrial policy and argued that it is ineffective.[16] Research has also focused on identifying the pitfalls of industrial policy for policymakers, especially information asymmetries, political capture, and crowding-out effects.[17] While insightful, the methodologies in these studies cannot be used to build aggregate estimates of industrial policy spending.

The existing literature rarely addresses the total costs or size of industrial policy. A recent joint report by the International Monetary Fund (IMF), OECD, World Bank, and WTO calls for more coordinated action on subsidies, including more transparency, which remains especially low for industrial subsidies.[18] Other scholars use some quantitative measures combined with qualitative and political analysis to determine whether industrial policy is increasing in China.[19] The French-government-affiliated think tank France Stratégie has conducted an in-depth review of French industrial policy and included some comparisons with other European and OECD countries. However, it appears that no recent study has attempted to estimate the size of industrial policy spending across key economies, including China.[20]

Overview of the Report

Chapter 2 of this report will introduce the methodology used to estimate the scale of state support in China, including choices about what kinds of measures were included or left out, and how each was measured. Not everyone will agree with these choices, but the aim is to be as transparent as possible about the chosen approach. This chapter will also provide the estimate of Chinese industrial policy spending, arranging the components of the estimate in a multilayered "stack" that allows readers to understand each component and its relative value.

Chapter 3 presents the methodology and estimates, again arranged in stacks, for the remaining seven economies. The aim in this chapter is to make a fair comparison across the economies; where this is impossible, the study tries to make like-by-like comparisons that, while not identical, are still acceptable facsimiles across the economies. This permits comparing not only the relative scale of state support but also the exposure of new patterns of approaches and tools from across the economies.

Chapter 4 offers a historical perspective on the industrial policy trajectories of the various economies in the study's sample, highlighting areas of similarity and divergence with China's path. It also highlights new trends that could affect industrial policy spending dynamics in the future.

Chapter 5 extends the comparative analysis by looking at three specific sectors. The case studies confirm the trends identified in the estimates and highlight the importance of other industrial policy tools that were unquantifiable at the macro level.

Lastly, Chapter 6 summarizes the report's findings and then discusses potential weaknesses of the analysis. It also identifies which types of industrial policy spending governments need to provide more information about. Finally, it discusses how greater information about countries' industrial policy spending patterns could affect the potential options that individual countries and international economic institutions have at their disposal to restrain the industrial policy spending of their trading partners and countries around the globe more generally.

2

Overcoming the Data Gap

Estimating China's Industrial Policy Instruments

Research for this report did not uncover any studies that have attempted a systematic comparison of overall industrial policy spending between China and other economies. Such data would be of use to U.S. policymakers at a time when industrial policy is gaining popularity in the United States and trade rules and institutions are under review internationally. This chapter includes the methodology and conservative estimates for various quantifiable forms of industrial policy spending by China. This analysis is also supplemented by a discussion of non-quantifiable channels of support.

Estimating the magnitude of China's industrial policies is especially difficult because data are scarce. Unlike other economies in the study (discussed in Chapter 3), China does not publish detailed figures on budgetary expenditures, estimates of fiscal expenditures by economic type, or the amount allocated to subsidy programs in its notifications to the WTO.

The lack of transparency is compounded by the complexity of China's unique party-state, its economic policymaking process, and the prominent role of state-owned enterprises (SOEs) in the economy.[1] The Chinese state is a major investor in both state-owned and private firms, blending state and private interests and ownership.[2] This can lead to underestimating state support for firms and creates methodological challenges when trying to compare China to other economies.

Nonetheless, there are ways to overcome these challenges, at least partially, and arrive at an estimate of China's total industrial policy spending. Three clear conclusions emerge from this report's analysis.

- First, China's industrial policy spending is enormous. In 2019, the quantifiable portions are at least 1.71 trillion yuan, or 1.73 percent of GDP (see Figure 2.2). This is equivalent to $248 billion at nominal exchange rates and $407 billion at purchasing power parity (PPP) exchange rates (see Figure 2.3).

- Second, China's instruments are diverse, but two stand out: direct subsidies to firms and below-market credit to SOEs.
- Third, from 2017 to 2019, China's total industrial policy spending kept up with GDP growth, resulting in steady spending as a share of GDP, except below-market land sales, which fell.

For most instruments, China's industrial policy spending does not appear to be declining over time. In fact, when looking at PPP exchange rates and not accounting for GDP growth, China's industrial policy spending has increased between 2017 and 2019 (Figure 2.3).

The study used 2019 as the benchmark year for China and other economies. While some data are available for 2020, the Covid-19 pandemic heavily distorted government spending and economies worldwide, suggesting that 2019 is a more representative benchmark for typical performance. To guard against the potential distinctiveness of any individual year, this chapter also includes estimates for 2017 and 2018 for China. Somewhat reassuringly—for the chosen methodology at least—industrial policy spending over that period was relatively stable.

The Challenge of China's State Sector

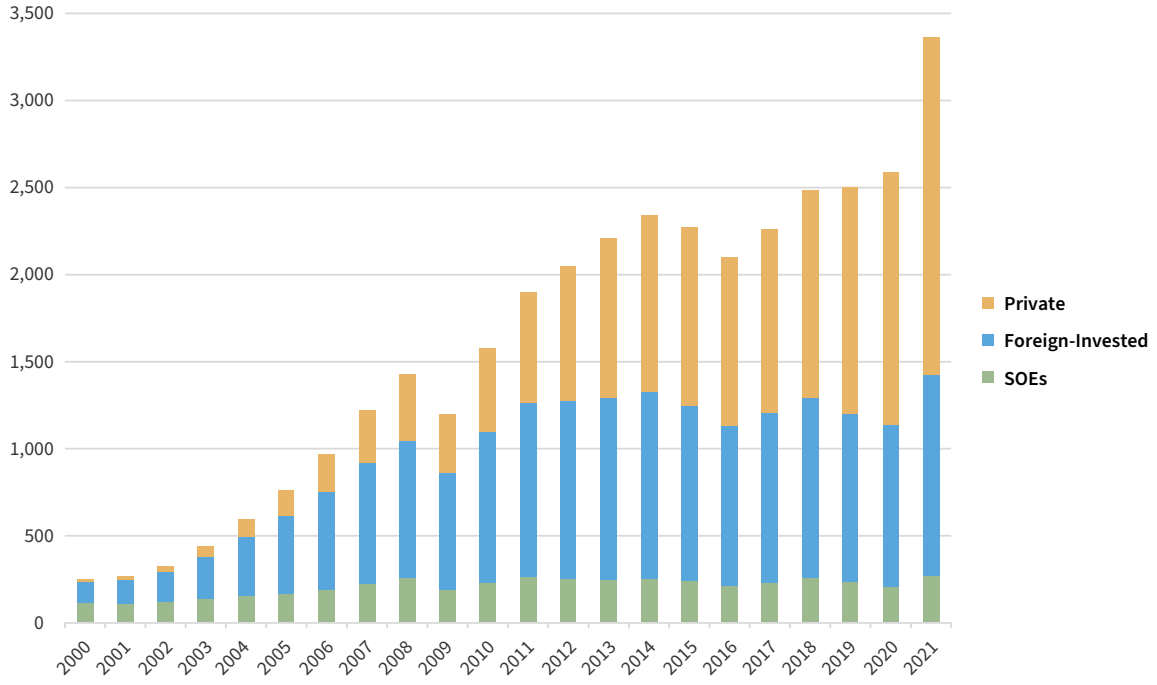
Most existing estimates of China's state support to firms, some of which are used in this project, focus on support to SOEs rather than to all firms. SOEs play a key role in China's policy goals, and China's SOEs are among the largest in the world, accounting for nearly all the growth of state-owned assets among the largest firms globally.

However, not all support to SOEs is necessarily industrial policy, and policies in support of SOEs do not represent the full scope of support to firms. This is particularly important because non-state firms account for most of China's corporate economic activity. For example, nearly all growth in China's exports in the past 20 years has been among non-state firms, initially from foreign-affiliated firms and more recently from Chinese non-state firms (see Figure 2.1).

Chinese officials frequently summarize the role of the private sector with the "60/70/80/90" formulation. The private sector accounts for 60 percent of GDP, 70 percent of innovation, 80 percent of urban employment, and 90 percent of new jobs.[3] Nonetheless, some policy instruments can only be estimated for SOEs because of data limitations, as discussed below.

Consequently, the methodology used here does not fully capture the close relationship between the state and the private sector in China, suggesting that the estimates understate support to the latter, especially unlisted private firms, including "national champions" in high-tech sectors.

Figure 2.1: China's Goods Exports by Firm Type
USD, billions



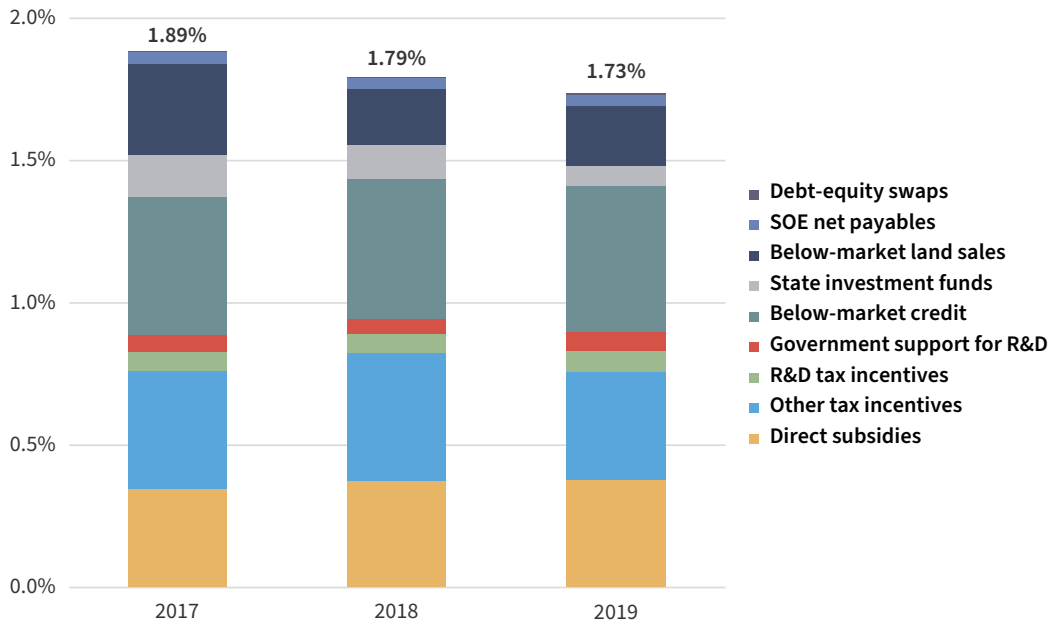
Source: "General Administration of Customs, Exports by Type of Enterprise," CEIC, https://www.ceicdata.com/en.

Building the Stack

The estimate of China's industrial policy spending includes nine categories of instruments based on limited data: direct subsidies to firms, R&D tax incentives, other tax incentives, government-financed business R&D, below-market credit to SOEs, state investment funds (government guidance funds), below-market land sales to firms, implied credit advantage among SOEs for their large net payables balances, and debt-equity swaps. The details and methodologies for each instrument are described below, with further details in the appendix. However, the quantitative estimates here only include instruments for which reasonable numeric estimates are possible. Hence, the study is forced to exclude many instruments, including market-access restrictions, localization requirements, government procurement, and the party-state's ability to guide capital markets. This report strives to take a conservative approach and avoid overestimating or double counting.

Figure 2.2: China's Quantifiable Industrial Policy Spending, 2017–2019

% of GDP

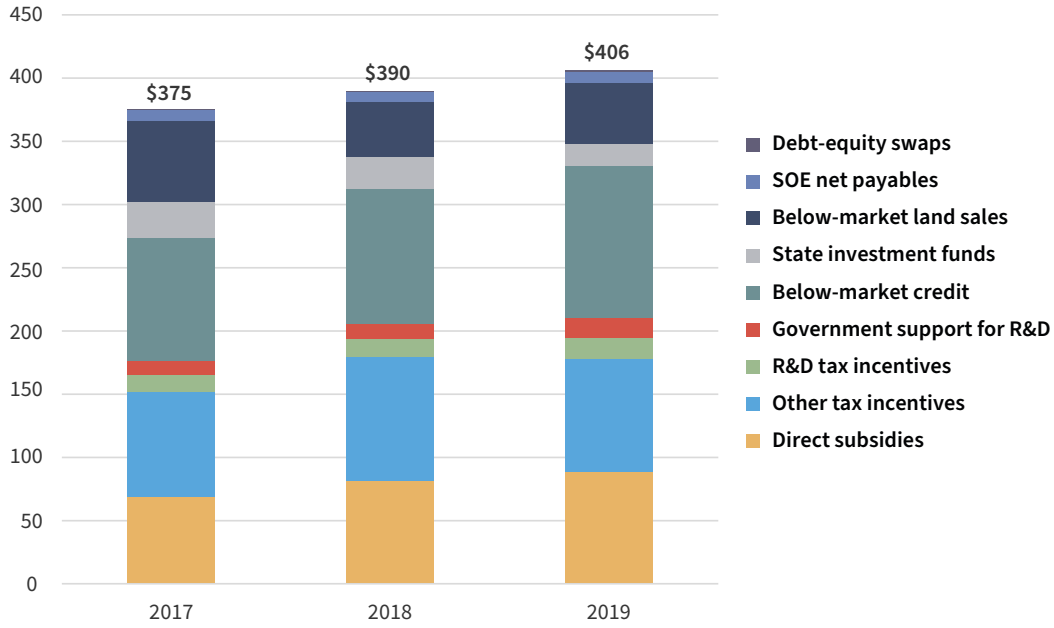


Note: Estimates are conservative and only include instruments with sufficient data for quantification.

Source: Authors' calculations; please refer to the appendix for detailed information.

Figure 2.3: China's Quantifiable Industrial Policy Spending, 2017–2019

USD, billions, PPP



Note: Estimates are conservative and only include instruments with sufficient data for quantification.

Source: Authors' calculations; please refer to the appendix for detailed information.

Direct Subsidies, R&D Support, and Tax Incentives

Chinese firms listed on domestic and foreign stock markets disclose details about their operations and cashflows in their stock market filings, including subsidies and tax rebates they receive. This listed firm data is the basis for much of the sectoral research on Chinese firms. Drawing on research from Gatley (2019), Lardy (2019), García-Herrero and Ng (2021), and data from WIND, the Chinese-based economic data provider, this study is able to estimate the "direct subsidies" and "other tax incentives" for China with data from listed firms.[4]

One shortcoming of this approach is that Chinese listed firms are not necessarily representative of all Chinese companies. Listed firms are biased toward larger and state-owned firms, with private firms underrepresented. SOEs accounted for about 60 percent of the market capitalization on China's large-cap stock index in 2019, even though they contributed only 25 percent of GDP.[5] On the other hand, small and medium-sized enterprises (SMEs), which are rarely listed, are generally private.

Chinese listed firms reported subsidies of 281 billion yuan in 2019 ($41 billion), with the share going to private firms almost equaling that going to SOEs in recent years.[6] From the data on listed firm subsidies, a picture emerges of how China is allocating its subsidies by sub-sector (see Figure 2.4). In absolute terms, most of the subsidies are directed at spending for capital goods, materials, and technology hardware. But relative to their profits, the biggest beneficiaries of subsidies are firms in software, technology hardware, automobiles, transportation, and semiconductors. This is not surprising, as these are all priority sectors for Beijing.

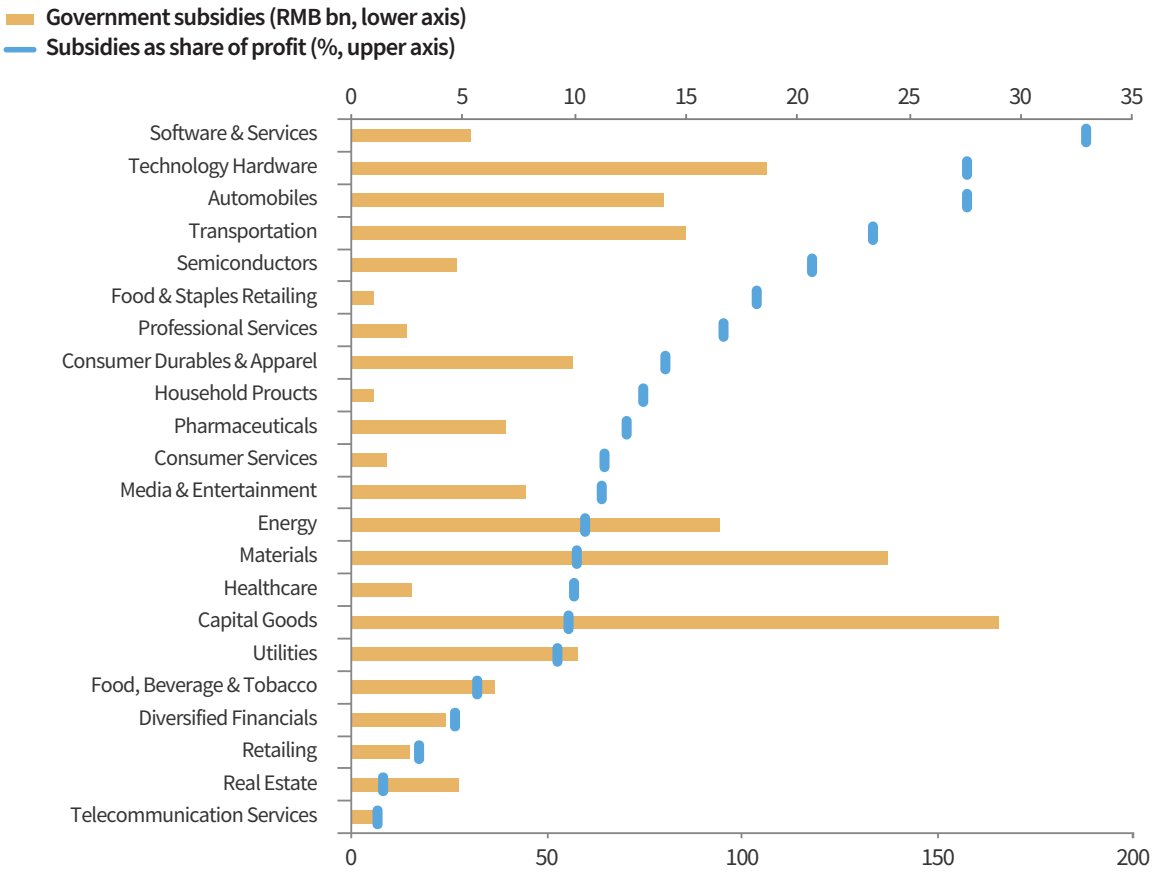
Total subsidies going to SOEs, both listed and unlisted, are estimated by applying the ratio of subsidies to sales for listed SOEs to total sales for all SOEs, as reported by the Ministry of Finance. Using this method and data from Gatley (2019), direct subsidies to SOEs were 304 billion yuan in 2019 ($44 billion). However, a similar method is not possible for extrapolating the total for listed private firms to all private firms, in part because the Chinese government does not publish total private firm revenues. Therefore, to estimate China's total direct subsidies, the study adds the estimated total for all SOEs with the reported subsidies for only listed private firms, yielding a total in 2019 of 437 billion yuan ($63 billion). This does not capture the full extent of subsidies to the private sector since non-listed firms are not included. If the full data were available, the estimate could be much higher. This method likely does not account for horizontal initiatives that target SMEs, which the report generally sought to exclude from calculations, as discussed in Chapter 3.

Chinese listed firms also report their total tax and fee refunds. This is broken down between SOEs and private firms, and the total refunds to all SOEs, both listed and unlisted, is estimated using the same methodology as described above. The estimate of China's "other tax incentives" combines the value of tax and fee refunds for all SOEs and listed private firms, totaling 410 billion yuan in 2019 ($59 billion). This estimate also leaves out tax incentives given to unlisted private firms.

However, the listed firm filings do not break down the type of subsidies, grants, or tax rebates. Some estimates of their relative contribution are made utilizing data from the OECD Tax Incentive Database. As discussed in the next chapter, OECD data for R&D tax incentives and government-financed business R&D are relied on for all economies in the sample when possible.[7] Because of the lack of public official data for China, the study utilizes a different methodology to estimate direct subsidies and tax incentives. Since some of the state support for R&D goes to listed firms, they probably report it in

their tax refunds and rebates or as grants in the case of government research programs. As a result, by simply adding to the stack the R&D tax incentives and government-financed business R&D data reported in the OECD database, the study might engage in double counting.

Figure 2.4: China's Direct Subsidies for Listed Firms per Sub-sector, 2017–2020



Note: Listed firms in both onshore and offshore markets included.

Source: Alicia García-Herrero and Gary Ng, "China's State-Owned Enterprises and Competitive Neutrality," *Policy Contribution* 5, no. 21 (February 2021), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3793470.

To address the issue, the study uses the following assumptions and calculations. The OECD estimates that SMEs receive 54 percent of the benefits from China's R&D tax support, while large firms receive the rest.[8] The SMEs can be assumed to be unlisted, but the large firms might be listed. To avoid double counting, the share going to large firms—46 percent—is subtracted from the estimate of "other tax incentives." Similarly, the study assumes that listed firms receive a portion of the funding from government-financed business R&D, although the share is unknown. To avoid double counting, this value is subtracted from the "direct subsidies" category.

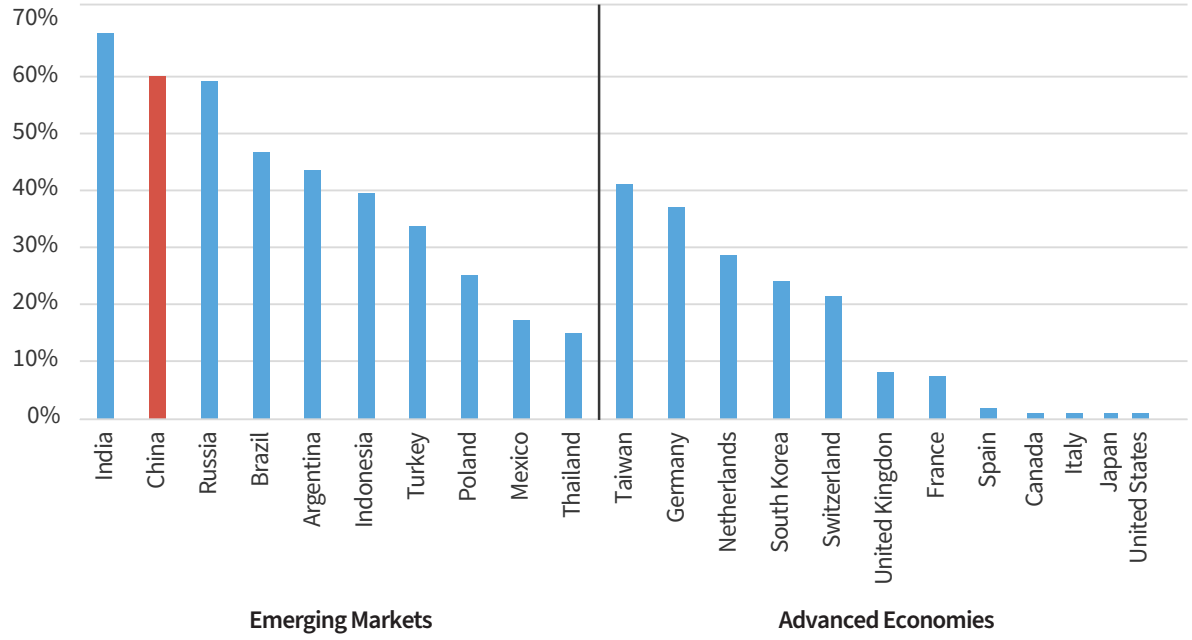
Below-Market Credit

Estimating below-market credit to firms in China is complicated by the state's dominance of the financial sector well beyond policy banks. For other economies in the sample, estimates are made using

primarily policy bank and export credit agency lending to firms. However, China's two largest policy banks—the China Development Bank (CDB) and China Export-Import Bank (Eximbank)—focus on lending for infrastructure projects and overseas financing, respectively. As of 2020, only 6 percent of the CDB's 13 trillion yuan ($1.9 trillion) in loans went to the manufacturing sector, with urban renewal, transportation, utilities, and other infrastructure projects accounting for the vast majority. [9] China Eximbank does not disclose a sectoral breakdown of its portfolio, but its mission is focused on trade and cross-border investment.[10] Instead, China's commercial banks—with 282 trillion yuan ($43.7 trillion) in domestic assets as of 2021—are the primary lenders to Chinese firms, including in priority industries.

China's financial sector is dominated by state-owned financial institutions. If state ownership is narrowly defined as at least 50 percent of equity held by the government, China's banking sector is 60 percent state owned, which is more than all other major economies except for India (see Figure 2.5). Under a broader definition of state ownership based on origins and largest shareholders, nearly all major Chinese banks are state owned. By comparison, foreign-owned banks accounted for only 1.4 percent of Chinese banking assets in 2021.[11] Furthermore, corporate financing in China is still dominated by bank loans, despite a growing bond market. Data from the People's Bank of China suggest that bank loans accounted for 71 percent of corporate credit in 2021, while bonds were only 18 percent.[12]

Figure 2.5: State-Owned Banks' Share of Banking System Assets, 2016



Note: State-owned banks are those with at least 50 percent of equity owned by national or subnational governments. Taiwan data as of 2020.

Source: IMF, *Fiscal Monitor: Policies to Support People During the COVID-19 Pandemic* (Washington, DC: IMF, April 2020), https://www.imf.org/en/Publications/FM/Issues/2020/04/06/fiscal-monitor-april-2020; and "Central Bank of the Republic of China, Domestic banks by total assets," CEIC, https://www.ceicdata.com/en.

Even though most banks operate outwardly on a commercial basis, the party-state can control their behavior through regulations, appointment of top executives, and regular issuance of policy guidance, allowing officials to have banks serve their policy goals.[13] Official statistics and bank disclosures are insufficient to estimate a consolidated balance of lending in support of industrial policy objectives.

Likewise, all lending to relevant sectors may not be motivated by policy objectives. Thus, tabulating industrial policy lending on a sectoral basis is not feasible.

Instead, the report looks at the interest rate advantage that SOEs enjoy relative to non-state firms. SOEs borrow cheaply—especially considering their generally lower profitability and credit efficiency compared to private firms—primarily because of the state's implicit backing of their debts.[14] Since 2008, private firms in China have paid on average 2 percentage points more in interest for bank loans.[15] Even after accounting for size, industry, and type of bonds, SOEs enjoy borrowing costs that are at least 1 percentage point lower than private firms.[16] Recognizing this credit distortion, the Chinese government has repeatedly called for expanded credit to nonstate firms.[17] But at the same time, Chinese leaders have reaffirmed that SOEs are to retain a major role in the Chinese economy.[18]

While the bond market is less important than bank lending in China, the former is more transparent and offers a window into the state's implicit guarantee. State-owned issuers account for the vast majority of Chinese bond issuances, but SOEs rarely defaulted on bonds until 2018. From 2014 to 2020, SOEs accounted for only 27 percent of cumulative corporate bond defaults in China.[19] Since 2018, SOEs have accounted for a growing share, as Beijing has tried to impose some market discipline.[20]

The borrowing advantage of SOEs in part reflects the Chinese government's preference for a strong state sector. As discussed in Chapter 1, this project uses an expansive view of governments' motivations for industrial policy, including political preferences for the structure of production. In China's case, one such goal is to preserve the role of SOEs in China's economy, which has been remarkably steady in GDP value-added terms over the past 20 years.[21] While the borrowing advantage of SOEs is not industrial policy per se under a narrow definition, it is a reasonable proxy—and the best available option—for estimating the state's implicit subsidies to firms through credit. If more detailed official data or bank disclosures were made public, it would be possible to more accurately measure China's below-market credit support for industrial policy.

To estimate SOE's borrowing advantage, this study uses Gatley's (2019) method and estimates.[22] Bond yields are easiest to compare because of available market data. On average, corporate bonds issued by SOEs have coupon rates 1.4 percentage points lower than bonds of the same tenor issued by private firms. Bank loan interest rates are less transparent, but it is possible to estimate the loan borrowing advantage of listed SOEs by comparing their reported interest payments to the estimated tenure of their loans and term premiums. On average, SOE bank loans have interest rates 0.5 percentage points below what private firms pay. The bond and loan spreads are applied to the outstanding balances of SOE corporate bonds and loans to arrive at the implied credit subsidy for SOEs, equal to at least 0.51 percent of GDP in 2019.

In share of GDP terms, this estimate is about half of the IMF's similar estimates of SOEs' borrowing advantage from 2001 to 2018.[23] This lower estimate is used because the methodology is more detailed and provides estimates for individual years instead of multiyear averages. However, the IMF estimates suggest that over time this advantage has been fairly steady relative to China's GDP.

The study also includes export loans from China Eximbank, similar to the estimates of other economies' credit support. While China Eximbank provides more support in absolute terms for exports than any other export credit agency analyzed here, the value is not exceptional as a share of GDP. It is also small compared to SOEs' borrowing advantage and has little impact on the overall total.

In sum, according to this methodology, China's below-market credit was equal at least to 509 billion yuan ($74 billion), or 0.52 percent of GDP, in 2019. This is the single largest instrument in this study's comparative estimate of China's total industrial policy spending, suggesting it is one of the most important ways in which the state supports domestic industries.

State Investment Funds

China's government guidance funds (GGFs) are a unique instrument for industrial policy. While other economies have some state investment funds, GGFs have proliferated in numbers, mandate, and size since 2014.[24] GGFs are intended to be market-oriented public-private equity investors controlled by Chinese governments but managed professionally. They are meant to provide "patient capital" for long-term investments in priority sectors, ideally early-stage companies. In practice, GGFs suffer from some deficiencies of design and execution, including poor management, risk aversion, an overreliance on state sector capital for "private" contributions, and redundancy across funds.[25]

By the end of 2020, 1,851 GGFs had been established, with a total designated funding scope of 11.5 trillion yuan ($1.7 trillion), according to research firm Zero2IPO. However, the actual funds raised are much lower, with a cumulative total of 5.65 trillion yuan as of 2020 ($820 billion).[26] The most well-known fund is the National Integrated Circuit Industry Fund, also called the "Big Fund," which was started by the central government in 2014 with an initial round of fundraising equal to 138.7 billion yuan ($22.6 billion).[27] GGFs controlled by subnational governments account for the majority, with central funds having targets of about 19 percent of the national total as of mid-2020.[28]

The scale of GGF investments is enormous, especially for state investors. While not a perfect comparison, the value of funds raised by GGFs annually from 2015 to 2020 was equal to a large share of the total venture capital and private equity investments made in China during those years (see Figure 2.6).

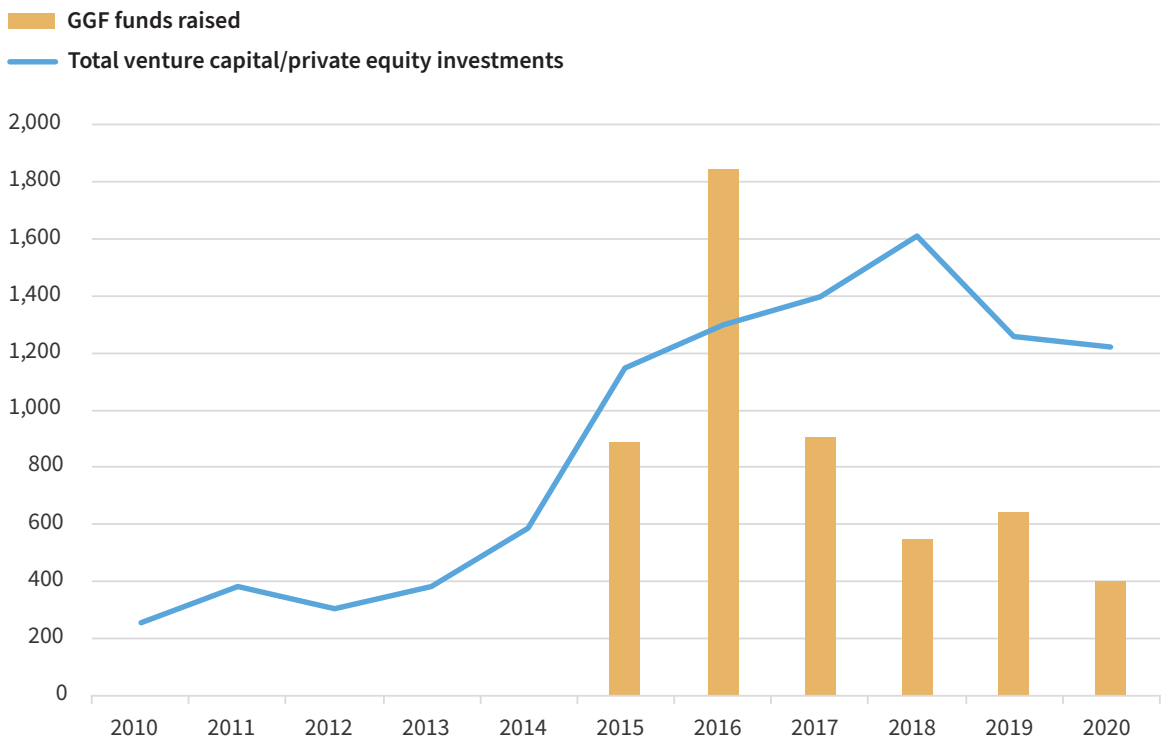
GGFs typically make equity investments in unlisted companies and start-ups in targeted sectors.[29] As such, getting a full picture of their total investment volumes, including what the funds are buying and at what price, is difficult. Overall, it is unclear when GGFs invest the funds they raise, but the funds must be invested eventually, otherwise the funds earn little to no return on their capital. For the estimate of China's state investment flows, the study takes the three-year average of funds raised by the GGFs, based on Zero2IPO data. This is because of significant fluctuations year to year and because it is unlikely that all funds raised in a year are invested in the same year.

Investment flows that are so large relative to market size are likely to be distortionary, pushing up valuations for target companies or sectors. This probably results in an above-market equity premium for the portfolio companies, which, as noted in Chapter 3, is difficult to estimate but is assumed to be 10 percent of the investment value, applied uniformly across the sample economies. This implies a subsidy of 70 billion yuan ($11 billion) for Chinese firms from GGF investments in 2018.

The lack of transparency on state investment fund flows and premiums is especially problematic for China given the size of its funds. But in other economies as well, there are a growing number of new funds to stimulate private equity and venture capital investment in innovation. More harmonization and transparency will be important in such initiatives internationally.

Figure 2.6: China's Private Equity Market, 2010–2020

RMB, billions



Source: Zero2IPO Research, "In 2020, the establishment of guidance funds will slow down, and some funds will invest more than a dozen sub-funds a year," Interface News, 2021, https://www.jiemian.com/article/5650611.html; "China: VC and PE: Value of Investment," CEIC, ChinaVenture, https://www.ceicdata.com/en.

Below-Market Land Sales

In China, all land is owned by the state (urban land) or by rural collectives (in the countryside). Localities can grant, lease, or allocate the right for firms to use the land.[30] These land sales—technically leases—are a major source of revenue for local governments.[31] But they are also an important instrument for industrial policy because localities can offer land-use rights at a concessional or below-market price, an implicit subsidy.

To estimate the size of this implicit subsidy, this study uses land transfer data available on the Chinese-based economic data provider WIND. Localities report the volume of their land sales, the average bidding price, and the price at which land is sold. A portion of these land sales are "negotiated" and are below the average market price. This estimate uses the difference in total transactions between negotiated and market price land transactions as a proxy for the subsidy accruing to firms. However, these data are not available after 2017. To estimate the values for 2018 and 2019, the average is taken for the three prior years. This yields an estimate of 206 billion yuan ($30 billion), or 0.21 percent of GDP, for below-market land sales in 2019.

However, the data available from WIND are not comprehensive. The IMF did similar estimates from 2001 to 2015, based on a land data set that is no longer available, which found that the implied land subsidy was more than 1 percent of GDP from 2010 to 2015.[32] This suggests that this study's estimate

significantly understates the extent of the implied subsidy. However, the IMF also found that land subsidies had declined significantly in GDP terms over time, suggesting this policy instrument is becoming less important and that this study's estimate may not be far off the mark.

SOE Net Payables

Chinese SOEs have domestic market and political power, which they can use to delay payments to private suppliers. They also maintain large net payables balances, which their private counterparties must offset with net receivables balances. In essence, Chinese SOEs compel their private partners to pay them promptly, while SOEs are not expected to pay their bills to private firms on time. This functions as an implicit zero-interest loan from private firms to the SOEs, the cost of which is borne by the private firms. The Chinese central government has repeatedly acknowledged the problem and its inconsistency with market principles.[33]

This implied subsidy to SOEs is estimated based on a methodology from Gatley (2019).[34] As of 2019, industrial SOEs had a net payables balance of 1.8 trillion yuan ($260 billion), based on industrial survey data.[35] Extrapolating to all nonfinancial SOEs, based on Ministry of Finance data, this implies an SOE net payables balance of over 7 trillion yuan in 2019 ($1 trillion).[36] If SOEs had to borrow from banks to obtain such a balance, they would pay 430 billion yuan ($62 billion) in interest based on the weighted average lending rate reported by China's central bank.[37] However, to be methodologically consistent with the below-market credit estimate, this balance of net payables is treated as debt that would have otherwise been added to total SOE debts, and the same estimate of SOEs' interest rate borrowing advantage is applied on loans. This implies a comparable subsidy of 38 billion yuan ($5.5 billion), equal to 0.04 percent of GDP in 2019.

Debt-Equity Swaps

Beijing launched a debt-for-equity swap program in 2016 to reduce corporate leverage, especially among SOEs. The program allows Chinese banks to exchange their loans for shares in the indebted company.[38] As of April 2019—the latest data reported—swaps worth 2.3 trillion yuan ($330 billion) had been signed, but only 910 billion yuan ($132 billion) of those swaps had been executed.[39] The program appears to have slowed, probably because banks did not see the terms as favorable.

The program can be considered an implicit subsidy for beneficiary firms, allowing them to reduce their debt loads and direct other sources of financing to other needs. To estimate this subsidy, this study assumes that the balance of swaps would otherwise have been SOE debts and applies the same spread that was used for the estimate of below-market credit for the sake of consistency. This yields a small implicit subsidy of 4.5 billion yuan ($650 billion) in 2019.

Other Instruments

There are other instruments that benefit specific firms or industries in China, many of which are not quantifiable or are inherent to the political economy of the country. In the latter case, these may be the result of delayed reforms rather than any strategic planning on the part of the state. Some of these dynamics and the mechanisms through which these tools are deployed will be further explored in Chapter 5, which will focus on sector-specific case studies.

Industrial policy in China has been evolving away from just using direct transfers to a more sophisticated system of guidance—"top-level design"—that deploys market-based tools to benefit targeted industries.[40] For example, Gatley notes that the combination of lower taxes and higher subsidies for firms in strategic sectors helps enhance their attractiveness to equity investment.[41]

Firms in strategic sectors are also explicitly prioritized when it comes to initial public offerings, both informally and formally.[42] Investment can also be influenced more directly by the state when it elevates certain sectors politically. Given the extraordinary power of the state, economic actors pay close attention to which industries are likely to receive continued political support (e.g., the semiconductor industry) and which are not (e.g., private education or social media companies). Private and institutional investors rely on documents such as the Five-Yean Plans or Made in China 2025 to identify which sectors and companies have the government's backing and are more likely to avoid crackdowns and receive bailouts.

Central government signaling of priority industries can affect economic choices even among other levels of government. Local governments in China are particularly important industrial policy actors. The country's political system provides incentives to local government officials to pursue growth in entrepreneurial ways, following political signals from the top which can at times be vague or conflicting.[43] Local governments can deploy a variety of tools to benefit firms, including below-market land sales, local GGFs, explicit subsidies, and their own political guidance. They are also often economic actors themselves, holding shares in companies or investing in GGFs.

China is not the only country that has skewed government procurement contracts toward domestic firms. But the sheer scale and scope of government-guided procurement is unique. In addition to normal government procurement, China's central and local governments can direct state-owned and state-controlled organizations—especially SOEs—to purchase specific technologies or brands or to buy from local companies. This can happen through formal or informal dynamics. For scale, China's nonfinancial SOEs in 2021 had revenues and total profits equal to 66 percent and close to 4 percent of GDP, respectively.[44] As noted in Chapter 2, the role of public procurement in industrial policy may be the largest tool not captured in estimates here, and qualitative research suggests that its use is particularly widespread in China.

Localization or joint venture requirements have been particularly important in some sectors, such as automobiles and wind turbines. The reduced importance of foreign firms and foreign direct investment (FDI) in China's economic growth over the past decade suggests that this tool is less important than 10 or 20 years ago. As Chinese firms approach or reach the innovation frontier, they are less likely to benefit from foreign technology transfers.

Finally, some have noted that dividends transferred from nonfinancial central SOEs to the state capital management budget appear to be small relative to the companies' after-tax profits. An even smaller share—2.4 percent in 2019—goes to the central general public budget.[45] This suggests that the state, which is generally a large shareholder, is forbearing on its right to extract dividends. While it is a dynamic that benefits SOEs, it is not classified here as outright industrial policy. The Chinese government has introduced targets to increase the contribution to the central general public budget. Moreover, there is no straightforward way to count what the value of the forbearance is since companies can and do pay dividends differently. It is worth noting that in other economies, including the United States, listed firms are free to not pay dividends at their discretion.

Summary

Some of the most powerful instruments in China's industrial policy tool kit derive from the party-state's power to direct the financial sector, including access to credit and capital markets, to support its policy objectives. This study's estimates of China's below-market credit and state investment funds reflect this dynamic. However, additional support is available to firms through other channels, as discussed above. Among other things, Chinese firms operating in strategic sectors receive support from the government in the form of political guidance of the economy.

This study's estimate demonstrates that China's quantifiable industrial policy spending is large, at least 1.73 percent of the country's GDP in 2019. These findings are also consistent with sectoral and qualitative research that shows a relatively sophisticated, albeit often wasteful, use of market-based tools and the country's political economy in support of policy objectives. Chapter 5 will delve further into this topic by analyzing three sectoral case studies.

While this chapter shows that conservative estimates of China's quantifiable industrial policy are possible, much remains opaque. Any critique of the methodological differences between estimates for China and other economies in this study must consider China's relative lack of transparency and data limitations.

3

China as the Big Spender

Comparative Estimates of State Support

Analytical Approach

The goal of this study is to provide a quantitative assessment of China's instruments of state support to industry compared to other major economies based on available data or reliable estimates. This chapter shows that China's quantifiable industrial policy spending (discussed in Chapter 2) is significantly higher than that of other leading economies both in nominal terms and as a share of GDP. This is the case even when excluding China's more unique tools of industrial policy, such as below-market land sales, let alone all the kinds of state support that cannot be quantified.

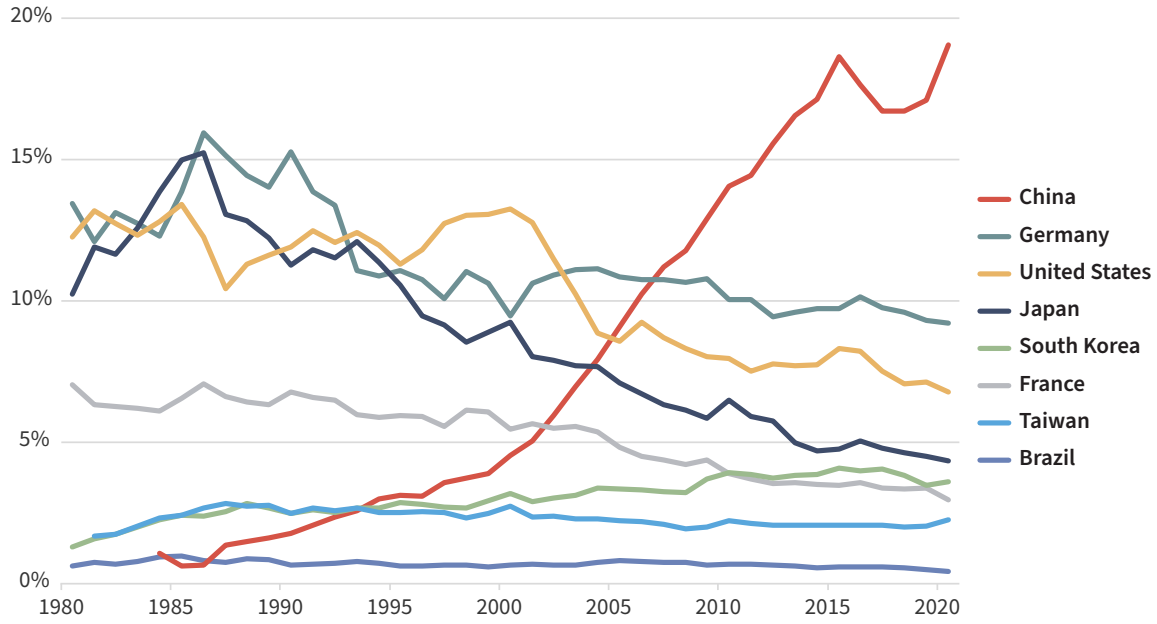
For this comparison, the study selected seven economies: Brazil, France, Germany, Japan, South Korea, Taiwan, and the United States. This selection covers places with a range of political economies that have followed different development trajectories, and hence each has its own tradition of industrial policy.

Japan, South Korea, and Taiwan are China's East Asian economic peers, and their development histories and strategies are often compared to China. France and Germany are the two largest European Union economies, with different traditions of state planning and intervention. Brazil is an emerging market economy that in key ways represents Latin America's experiences with industrial policy. Finally, the United States is the world's largest economy in nominal terms.

The economies compared in this study also vary substantially from each other, allowing for useful comparisons and contrasts. In aggregate economic terms, the United States and China lead the world. In 2021, the United States accounted for 23.9 percent of global GDP at market exchange rates, while China was 18.1 percent, according to IMF estimates. Japan and Germany were third and fourth, at 5.1 percent and 4.4 percent, respectively.[1]

However, China's economic footprint is much larger in manufacturing and as a central hub of global supply chains. China's gross value added in manufacturing is larger than any other economy. In 2020, China's manufacturing goods exports accounted for 19 percent of the global total, with Germany and the United States in a distant second and third place, respectively (see Figure 3.1). China's role as the leading industrial power makes it even more important to understand the extent of state support to Chinese firms.

Figure 3.1: Share of World Manufacturing Exports, 1980–2020



Source: "World Bank, Manufacturing exports; Taiwan Ministry of Finance, exports," CEIC, https://www.ceicdata.com/en.

Identifying Instruments

To decide what policy instruments to include in this estimate and ensure comparability across economies, the project team considered two key questions.

First, which policy instruments can be quantified—either with existing data or new calculations—at the aggregate level? Many micro-level estimates exist for various tools, but most of these cannot be aggregated across all sectors or for the whole economy. There are several instruments for which state support to firms cannot be quantified in a comprehensive way. These include localization requirements for foreign investors; restrictions on domestic competition, such as state-granted monopolies; protective tariffs; and administrative guidance.

In general, it is easier to estimate instruments that involve fiscal outlays or appear on the balance sheets of state-affiliated financial institutions. Some instruments are important to industrial policy but might not involve implicit "subsidies" at all, such as targeted liberalization measures to allow FDI in strategic sectors or controlled market access for imports. For other instruments, data on total value may be available, but the implied subsidy can be difficult to estimate.

Second, what is the actual degree of state support—the subsidy—captured by the instrument estimate? Estimates of state support need to be conceptionally comparable. For example, the nominal value of a government-sponsored investment, state loan, or government procurement contract is not state support per se. What should count as state support or a subsidy is (1) any premium paid above market prices for equity investments or procurement and (2) the spread between interest rates at market terms and lower interest rates offered by state financial institutions for loans.

Based on research and consideration of the above questions, the project team categorizes quantifiable industrial policy instruments across these economies into six categories: direct subsidies, tax incentives for R&D, government support for business R&D, other tax incentives, below-market credit, and state investment funds. An overview of each instrument can be found in Table 3.1.

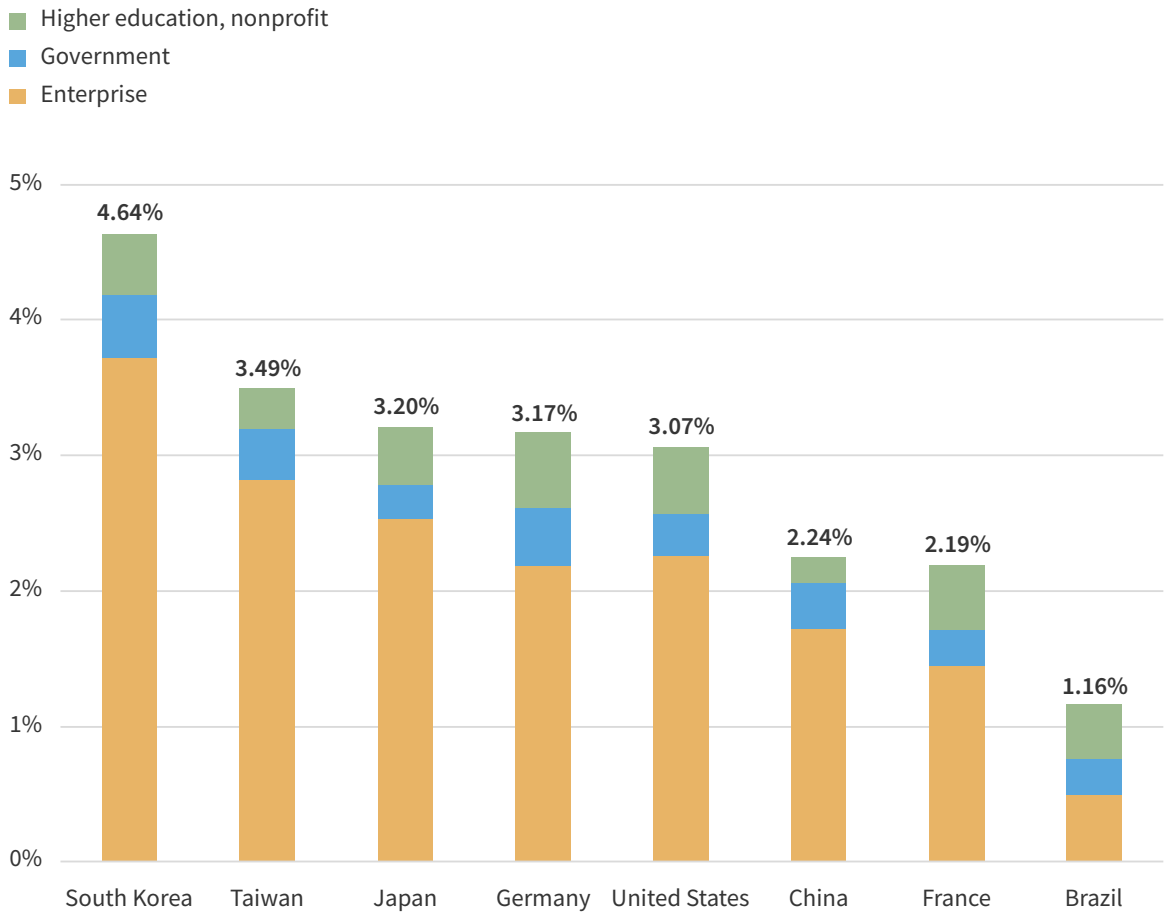
Table 3.1: Estimated Instruments

Instrument	Description
Direct subsidies	Explicit subsidies to firms, excluding those for R&D projects.
Tax incentives for R&D	Tax credits and rebates to encourage business R&D spending.
Government support for R&D	Direct government funding of R&D activities conducted by business enterprises, such as research grants for national projects.
Other tax incentives	Business tax incentives and rebates unrelated to R&D.
Below-market credit	Loans from state policy or development banks and export credit agencies to firms in relevant sectors. Implied credit subsidy estimated with a credit spread (explained below).
State investment funds	New state equity investments in domestic firms, including private euqity and venture capital funds. Implied equity premium estimated (explained below).

R&D tax incentives and government support for business R&D are included because of the importance of these tools. Even though R&D support is a horizontal tool in theory, it is often more targeted in practice, such as government grants for research projects in priority sectors. General R&D tax credits disproportionately benefit R&D-intensive industries.

Total R&D spending as a share of GDP for each economy can be found in Figure 3.2. South Korea is the standout, with R&D spending of 4.6 percent of GDP in 2019. However, in GDP terms, there is not much variance in the amount of R&D conducted by the government and higher education sectors across these economies. The key difference is the amount of R&D conducted by enterprises, which is supported by R&D tax credits and direct funding by governments.

Figure 3.2: Total R&D Spending as Share of GDP, 2019



Note: Brazil data are from 2017.

Sources: "Gross domestic expenditure on R&D by sector of performance and source of funds," OECD, https://stats.oecd.org/Index.aspx?DataSetCode=GERD_SOF; "Trends in research expenditure in Brazil," United Nations, https://www.unesco.org/reports/science/2021/sites/default/files/medias/files/2022/02/Brazil-Figure-8-2.pdf.

Two other instruments bear further explanation: below-market credit and state investment funds. The OECD has developed a methodology for estimating below-market credit benefits or above-market equity premiums for individual firms, but this approach cannot be scaled as an aggregate metric.[2] Few state-affiliated banks report average lending rate estimates or implied subsidies. Most claim to operate on a commercial basis at market rates. Yet, development banks and export credit agencies are prominent in most of the sample economies. Even if development bank loans and export credit agencies are lending at market rates, they may be extending credit to companies that might otherwise struggle to obtain credit at those rates.

As a rough proxy for the implied subsidy or extent of below-market financing, the study applies an interest rate spread for each economy to the balance of relevant loans as of 2019. Except for Brazil and China, this spread is calculated as the average difference in local currency corporate bond yields between investment-grade and high-yield-grade bonds in those markets in 2019, based on Bloomberg data. This provides an approximation of the degree of credit enhancement, or lower borrowing costs, a

firm might expect to receive from a concessional lender. For Brazil, bond market data are insufficient to replicate this method. Fortunately, the Brazilian Development Bank reports its average lending rate, which is often below the central bank's benchmark (Selic rate). The study uses the difference between the two rates as a proxy for the credit spread for Brazil. For China, a different method is used, which is explained in Chapter 2. This method is admittedly an approximation, but the spreads are similar across five of the economies,excluding the United States and Brazil, which are both outliers, with spreads of 2.25 percent and 3.52 percent, respectively.

Estimating an aggregate equity premium from state investment funds is more difficult. Many of these state funds invest in unlisted firms, and they rarely report data about the price per share at the time of purchase. Private equity or venture capital funds are often uncertain about the market value of their unlisted share holdings. For the sake of consistency, a 10 percent spread is applied to new equity investments from state funds for all economies. New investments are calculated as an annual flow value. Unlike loans, where balances are more stable over time and firms steadily benefit from below-market interest payments, firms receiving state equity investments primarily benefit at the time of the share purchase or infusion. State support is approximated by multiplying the flow of new investment by the premium. In cases where state funds were passive and did not make new investments, such as in Brazil, the study assumes there was no implied subsidy to firms.

Across instruments, the study needed to decide what kinds of programs, sectors, or subsidies to count. To do this, the study team surveyed previous research and consulted with experts from multiple economies and organizations. To limit the scope of the instruments to the study's definition of industrial policy, several factors are excluded in data compilations to the extent possible:

- **Agricultural, fisheries, or energy subsidies** are excluded except insofar as they target related firms or technologies. Many economies subsidize agriculture and fisheries, but that does not fit into this study's definition of industrial policy. Energy subsidies are also common and typically target consumers by keeping prices artificially low. In China's case, electricity subsidies overall favor households, not industries, and as such are a type of social support rather than industrial support.[3]
- **Infrastructure and education** are excluded because these are horizontal policies and often part of government spending irrespective of industrial policy.
- **Regional development programs** are excluded because these typically focus on reallocating resources internally. The targets of regional development initiatives can be very different from those of industrial policy, which target specific sectors at a national level.[4]
- **SME programs** are excluded unless directed toward specific sectors or innovation goals. Otherwise, SME programs are a type of horizontal industrial policy.

There are at least two common instruments of industrial policy for which quantification of state support is challenging: (1) state credit guarantees and insurance and (2) government procurement. Many development banks and export credit agencies provide guarantees or insurance instead of direct loans. The overall value of the guaranteed or insured credit instruments is often large and greatly exceeds the state-sponsored advantage to the borrower. Therefore, the study team decided to exclude credit guarantees and insurance.

The report also excludes government procurement because of data limitations. Government procurement may be the most important industrial policy tool not captured by this study's estimates.

Procurement, even when at market prices, can increase economies of scale for firms and boost their profits, an indirect but nonetheless important form of state support. In theory, implied state support from government procurement could be estimated by comparing the executed contract price on a good or service compared to the prevailing market price.

However, data on government procurement are irregular and not detailed. WTO submissions and OECD data offer some estimates of government procurement. The values are large and vary widely, with an average spending of 12 percent of GDP among OECD economies.[5] Some of this variation is due to certain governments procuring goods and services for public healthcare systems. Even for signatories of the WTO Agreement on Government Procurement—which includes all the economies analyzed in this study except Brazil and China—obtaining comprehensive data on procurement spending by use or type of contract is difficult.[6] Descriptions of types of bidding or contracts are inconsistent across economies and insufficiently detailed to determine above-market premiums. The OECD has highlighted the need for improved transparency of government procurement data.[7] Finally, an even more difficult dimension to capture is that governments regularly award contracts based on political considerations, often preferring local companies.

Sources

This report relies on official data sources or data collected by reputable organizations that rely on government data, such as the OECD or the WTO. For economies besides China, when components cannot be disaggregated to exclude areas beyond the study's scope, such as infrastructure investment or horizontal support to SMEs, inclusion is favored at the risk of over-counting. This may lead to some overestimation in economies other than China. For details on the sources and methodology for each economy in the sample, please refer to the appendix.

Data availability and differing levels of transparency are a major challenge. China is by far the least transparent government of those in the sample, with only limited government disclosures and no estimates of the size of its subsidies and other state support in its WTO declarations.[8] To compile estimates for other economies, the study team examined budgets, WTO notifications, annual reports from development banks or agencies, OECD estimates, and other sources. However, transparency does not necessarily mean harmonization of reporting standards across economies. In some cases, the study team struggled to identify comparable measures and disaggregate relevant spending, lending, or investments from reports that could allow for measuring state support accurately.

China's political economy—with state ownership of major financial institutions, state ownership of major firms and land, and strong political guidance over the economy—also raises issues for comparability with other economies. China's relative lack of transparency and unique political economy requires the study to use different methodologies to estimate some of its policy instruments, as discussed in the previous chapter.

Some other economies also have peculiarities, such as the European Union's provision of state support for its member economies separate from government support within each member state. However, to the extent possible, the study tries to assess analogous policies across the economies in the sample. Key methodological notes for each economy are presented in Table 3.2.

Table 3.2: Methodological Notes for Sample Economies

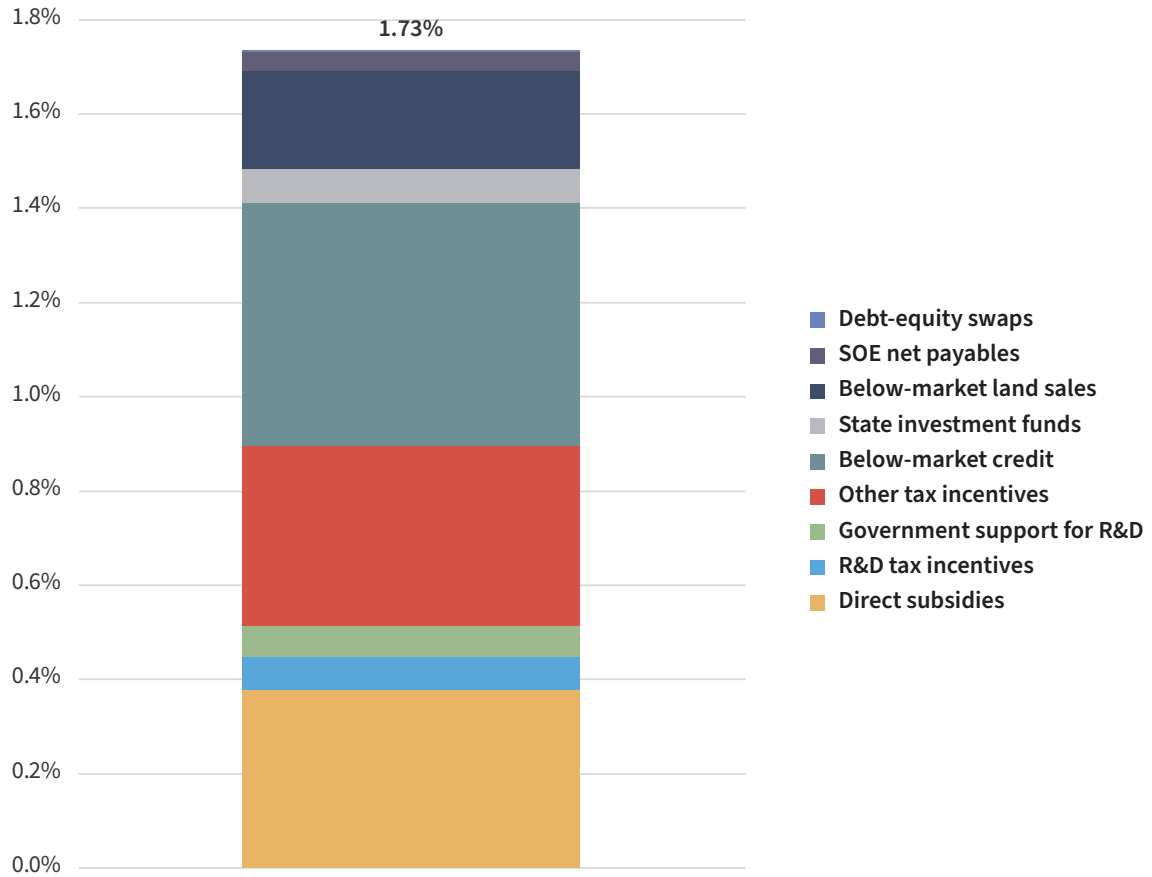
Economy	Notes
Brazil	Subnational spending is undercounted, especially for direct subsidies and other tax concessions, due to a lack of available data. The primary government-owned equity investment fund at the Brazilian Development Bank did not make new investments between 2017 and 2019.
China	Direct subsidies are undercounted because they exclude unlisted private firms, and government support for business R&D is subtracted from the total to avoid any double counting. The below-market credit estimate is based on SOEs' borrowing advantage. China-specific instruments, including below-market land sales and SOEs' net payables advantage, are not counted in the international comparison. See Chapter 2 for more details.
France	For "direct subsidies" and "other tax incentives," the study relied on France Stratégie's estimates of tax and subsidy support, excluding R&D to France's manufacturing sector. This may result in slight undercounting, but it may also include horizontal measures. To estimate EU support, the study includes an estimate of R&D funds from Horizon 2020, which may include some overlap with the OECD data on government-financed support for business R&D. The credit estimate probably captures horizontal support for SMEs, which cannot be disaggregated. The R&D support estimate most likely includes double counting because it includes numbers reported in the OECD database as well as in the WTO notification. At most, the double counting leads to an overestimation of less than 0.1 percent of GDP.
Germany	Germany did not have a dedicated R&D tax incentive prior to 2020. The estimate for direct subsidies includes local government and federal government grants and likely is an overestimation because it includes all grants reported by the Ministry of Finance for "trade and industry." To estimate EU support, the study includes an estimate of R&D funds from Horizon 2020, which may include some overlap with the OECD data on government-financed support for business R&D. The credit estimate captures significant horizontal support to SMEs and support to commercial banks, which cannot be disaggregated. The R&D support estimate likely includes double counting and is likely an overestimation.
Japan	The study team was unable to locate detailed tax expenditure data from the Ministry of Finance, so the "other tax incentives" estimate is likely underestimated. The R&D support estimate likely includes double counting and is likely an overestimation.
South Korea	State investment is likely undercounted. For example, no data on equity investments made by Korea Science & Technology Holdings could be found. The funding structures for both the Foreign VC Investment Fund and the Fund of Funds for Industrial Technology Commercialization are opaque, and it is unclear if their investments are captured in the data. The R&D support estimate likely includes double counting and is likely an overestimation.
Taiwan	Data collection was complicated by Taiwan's political status, which results in less international comparative data that includes Taiwan, such as from the OECD. The study team could not identify any direct subsidies other than those that could be categorized as government support for R&D. State investment is estimated by the difference in long-term investments between 2019 and 2018 reported by the National Development Fund.
United States	State and local spending on direct subsidies and tax concessions are included. Defense Advanced Research Projects Agency (DARPA) and Advanced Research Projects Agency–Energy (ARPA-E) research grant and investment totals are counted as government support for R&D, although these figures might overlap with OECD estimates, suggesting the total value may be overestimated. Small Business Administration programs are excluded because they were determined to be horizontal policies.

The study team chose 2019 as the reference year. While some data are available for 2020, the Covid-19 pandemic heavily distorted government spending and economies worldwide, suggesting that 2019 is a more representative benchmark for normal activities. This means that more recent initiatives such as innovation-focused recovery plans introduced in response to the pandemic in places including the European Union (e.g., the European Chips Act) or Japan are not included in the analysis. There may be an opportunity for future updates of this analysis to test whether the resurgence of interest in industrial policy is translating into higher government spending globally.

Findings: Industrial Policy across Economies

Estimates of industrial policy spending by instrument across these eight economies are presented below. Values are calculated as shares of GDP, in purchasing power parity (PPP) dollars, and in dollars at market exchange rates. Figure 3.3 shows China's spending, counting the China-specific instruments of land subsidies, SOE net payables, and debt-equity swaps. These instruments are excluded for the cross-economy estimates to make the comparisons as direct as possible and to demonstrate China's relatively large spending even with a conservative estimate.

Figure 3.3: China's Quantifiable Industrial Policy Spending, 2019
% of GDP

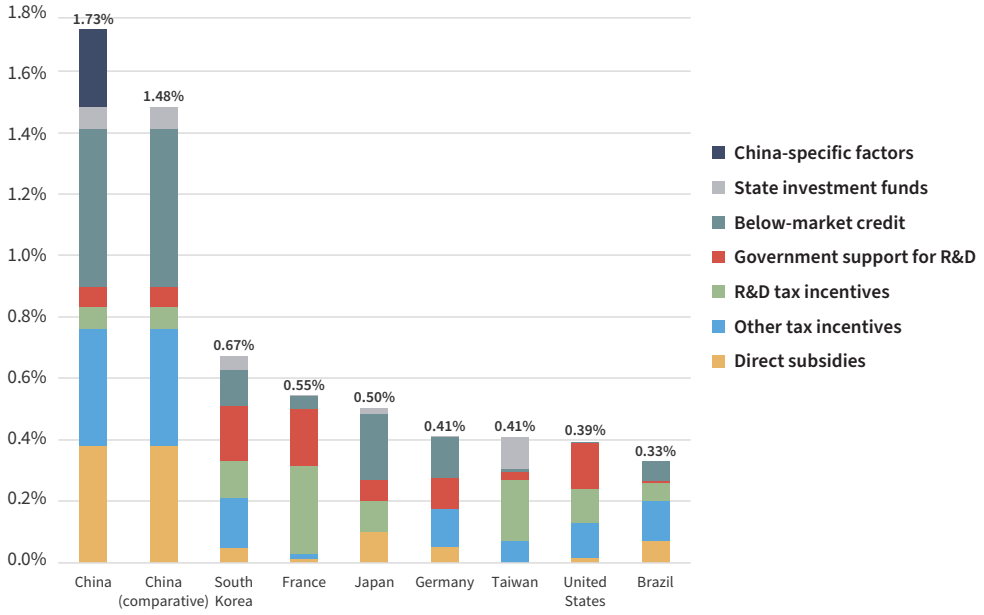


Note: Estimates only include instruments with sufficient data for quantification. China estimates are conservative.

Source: Authors' calculations; please refer to the appendix for detailed information.

Figure 3.4: Industrial Policy Spending in Key Economies, 2019

% of GDP

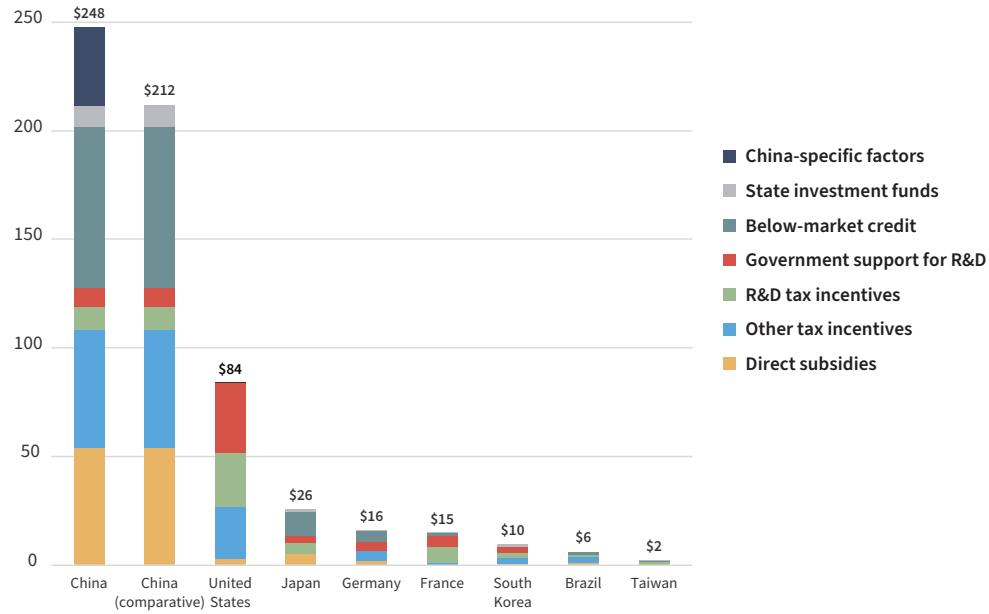


Note: Estimates only include instruments with sufficient data for quantification. China estimates are conservative.

Source: Authors' calculations; please refer to the appendix for detailed information.

Figure 3.5: Industrial Policy Spending in Key Economies, 2019

USD, billions, market exchange rates

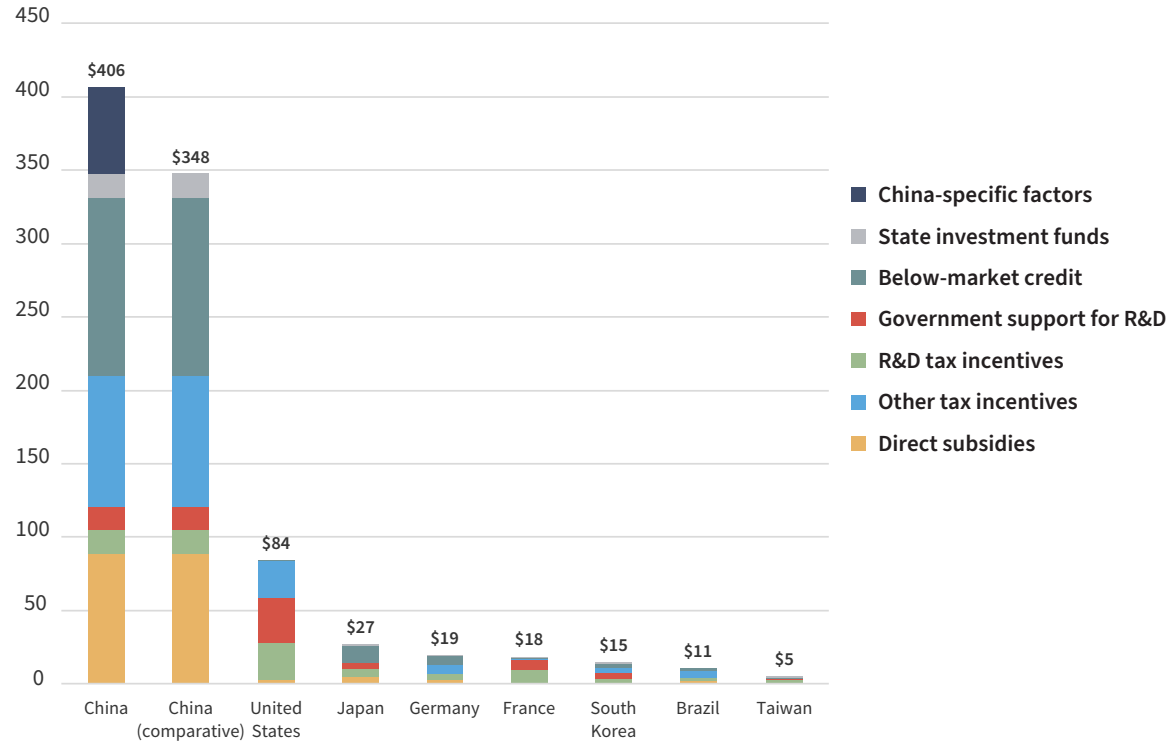


Note: Estimates only include instruments with sufficient data for quantification. China estimates are conservative.

Source: Authors' calculations; please refer to the appendix for detailed information.

Figure 3.6: Industrial Policy Spending in Key Economies, 2019

USD, billions, PPP



Note: Estimates only include instruments with sufficient data for quantification. China estimates are conservative.

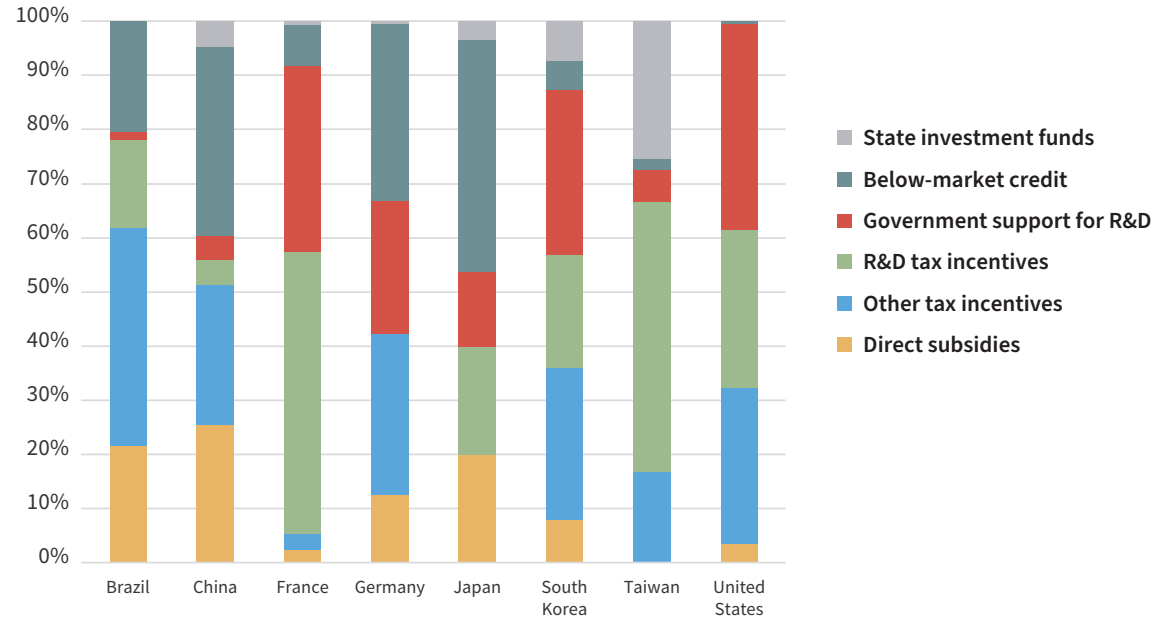
Source: Authors' calculations; please refer to the appendix for detailed information.

Even when utilizing a conservative methodology, China is an outlier. It spends far more on supporting its industries than any other economy in the study even when excluding China-specific factors. This is true in terms of share of GDP, but the disparity is even more apparent in dollar terms (see Figures 3.4, 3.5, and 3.6). As a share of GDP, China spends twice as much as South Korea, which is the second-largest relative spender in the sample. In dollar terms, China spends more than twice as much as the United States (see Table 3.3).

This distribution of industrial policy spending tells us something about the overall approaches of each economy (see Figure 3.7). The "R&D First" economies—France, South Korea, Taiwan, and the United States—lean disproportionately toward supporting R&D through tax incentives and government support for R&D. The "Big Investor" economies—China, South Korea, and Taiwan—all assign relatively large roles to state investment funds. Finally, the "Policy Bankers"—Brazil, Germany, and Japan—all rely extensively on policy banks. China, however, spends more on direct subsidies than other economies—both in absolute terms and as a share of its total spending—and provides disproportionate support through credit thanks to its state-owned banking sector.

Even when utilizing a conservative methodology, China is an outlier. It spends far more on supporting its industries than any other economy in the study.

Figure 3.7: Industrial Policy Spending in Key Economies, 2019
% of total spending



Source: Authors' calculations; please refer to the appendix for detailed information.

China's government guidance funds may be its most unique policy tool (see Chapter 2). While some other countries have funds that act like private equity funds or venture capital funds, they are nowhere near the size of China's in absolute terms. While South Korea and Taiwan have sizeable equity investment funds, as a share of GDP these are almost negligible in dollar terms (see Figures 3.4 and Table 3.3). China's government guidance funds are so large that they are likely crowding out private investment with distortive effects that make it hard to identify a market price.

Economies other than China rely heavily on tax incentives, which are captured in the "R&D tax incentive" category as well as the "other tax incentives" category (see Table 3.3). In some economies, these tax incentives are used to counteract the negative effect on competitiveness of high levels of taxation, such as in France. Yet, China still provides more tax incentives and rebates than any other economy.

R&D support, through direct government financing of business R&D or tax incentives, is the preferred instrument of support in most advanced economies in the sample, with the notable exception of Germany. The latter introduced a dedicated R&D tax credit in 2020, suggesting that a more recent assessment might show a different picture in this regard.

Below-market credit is particularly notable in countries with large development banks, including Brazil. Because the United States lacks an institution through which to target loans to industry (the Small Business Administration is excluded as a horizontal SME-focused institution), credit is not a significant tool. Instead, the United States relies far more extensively on tax incentives. For more on methodological choices, refer to Table 3.2 and the appendix.

For a more detailed discussion of China's unique industrial policy see Chapter 2. A more in-depth analysis of the economies in the sample and their historical and future trajectories is provided in Chapter 4.

Table 3.3: Industrial Policy Spending in Key Economies, 2019

	Brazil	China	France	Germany	Japan	South Korea	Taiwan	United States
	Millions of U.S. dollars (market exchange rates)							
	Millions of U.S. dollars (purchasing power parity exchange rates)							
	% of GDP							
Direct subsidies	1,344	53,865	362	2,020	5,158	774	-	2,895
	2,326	*88,389*	*442*	*2,438*	*5,425*	*1,038*	-	*2,895*
	0.07%	**0.38%**	**0.01%**	**0.05%**	**0.10%**	**0.05%**	**0.00%**	**0.01%**
R&D tax incentives	1,007	10,062	7,748	-	5,148	2,019	1,201	24,677
	1,742	*16,510*	*9,481*	-	*5,415*	*2,709*	*2,473*	*24,677*
	0.05%	**0.07%**	**0.28%**	**0.00%**	**0.10%**	**0.12%**	**0.20%**	**0.12%**
Government support for R&D	98	9,385	5,111	3,944	3,549	2,918	146	31,820
	169	*15,400*	*6,255*	*4,761*	*3,733*	*3,915*	*300*	*31,820*
	0.01%	**0.07%**	**0.19%**	**0.10%**	**0.07%**	**0.18%**	**0.02%**	**0.15%**
Other tax incentives	2,492	54,710	448	4,728	-	2,687	408	24,171
	4,312	*89,776*	*548*	*5,707*	-	*3,606*	*840*	*24,171*
	0.13%	**0.38%**	**0.02%**	**0.12%**	**0.00%**	**0.16%**	**0.07%**	**0.11%**
Below-market credit	1,261	73,645	1,121	5,217	11,072	530	52	405
	2,181	*120,848*	*1,372*	*6,298*	*11,646*	*2,624*	*112*	*405*
	0.07%	**0.52%**	**0.04%**	**0.13%**	**0.22%**	**0.12%**	**0.01%**	**0.00%**
State investment funds	-	10,103	101	82	864	699	609	-
	-	*16,578*	*123*	*99*	*909*	*937*	*1,254*	-
	0.00%	**0.07%**	**0.00%**	**0.00%**	**0.02%**	**0.04%**	**0.10%**	**0.00%**
China-specific factors	-	35,951	-	-	-	-	-	-
	-	*58,993*	-	-	-	-	-	-
	0.00%	**0.25%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**
Total	6,202	247,720	14,891	15,990	25,790	9,627	2,416	83,967
	10,730	*406,496*	*18,221*	*19,302*	*27,129*	*14,829*	*4,978*	*83,967*
	0.33%	**1.73%**	**0.55%**	**0.41%**	**0.50%**	**0.67%**	**0.41%**	**0.39%**

Note: Estimates only include instruments with sufficient data for quantification. China estimates are conservative.

Source: Authors' calculations; please refer to the appendix for detailed information.

Conclusion

The estimate presented in Chapter 2 demonstrates that the Chinese state invests significant resources toward industrial policy. In 2019, industrial policy spending in China added up to from somewhere between 1.48 percent and 1.73 percent of GDP, depending on whether unique China-specific factors are counted, even when applying a conservative methodology and counting only quantifiable factors. This chapter shows that when viewed in a comparative perspective, China's level of support to its firms is uniquely high.

As mentioned in the previous chapters, there are still significant gaps in the data that make it particularly challenging to calculate precise estimates of state support to industry and do so in a comparable way. This report strives to use a rigorous approach and be transparent about methodological choices (see the appendix). However, this study is likely overestimating expenditures for some tools for economies other than China or is unable to make a reliable estimate. More transparency and standardized reporting would make it significantly easier to assess to what degree states are supporting local firms and make international comparisons.

Chapter 4 will discuss the industrial policy trajectories of the economies in the sample, including recent trends. Chapter 5 provides more granular estimates for three sectors that help shed light on which tools may be underestimated.

4

China's New Path

Comparative Evolutions of Industrial Policies

This chapter compares the evolution of industrial policies in the eight economies, from their peak—often decades ago—until today. This includes a discussion of recent initiatives, including in response to the Covid-19 pandemic, which do not appear in the quantitative estimates for 2019 detailed in Chapters 2 and 3.

In most economies—with the notable exception of China—vertical industrial policies were most pronounced before the 1980s. This included classic import substitution strategies, deployed in Brazil and other Latin American countries, and plans with a strong directive role for the state, such as France's doctrine of *dirigisme*.[1] By the mid-1980s, such policies fell out of favor in response to slowing economic growth, fiscal constraints, and maturing industries. The "Washington Consensus," which emerged in the 1980s and 1990s, prioritized structural adjustments and horizontal measures while deemphasizing "market failures." This market-led approach achieved political legitimacy in many countries.[2]

Since the 2000s, industrial policies in many economies have focused on state support for innovation, R&D, and SMEs. Most vertical interventions remain out of favor except at earlier stages of firm development, in part because supporting developed industries, whether through implicit subsidies or protections, is more expensive and distortionary and perceived to be an obstacle to innovation. Some governments also remain wary of the risks of political capture and corruption that can coincide with direct interventions.[3]

Furthermore, the WTO and cross-governmental pressures have limited the scope and intensity of state support to firms, including by allowing countervailing measures in response to prohibited or actionable subsidies.[4] These rules and norms preclude economies today from adopting development strategies that were more common in past decades. For example, the export subsidies in place in South Korea until the mid-1980s are now prohibited under WTO rules.[5]

China's rise and use of industrial policies, geopolitical tensions, supply chain concerns, decarbonization targets, and other goals have led to a resurgence of interest in targeted interventions by some governments, including in the West. Advanced economies, however, remain biased toward R&D, tax incentives, and earlier-stage investment supports.

The international evolution of industrial policies is summarized in Table 4.1.

Table 4.1: Evolution of Industrial Policies

	Until the 1970s	1980s–1990s	2000s and ongoing	Recent/emerging
Key features/themes	▬ Industrialization ▬ Structural transformation	▬ Stabilization ▬ Liberalization	▬ Knowledge economy ▬ Global supply chains	▬ Sustainable development ▬ Strategic competition
Policy goals	▬ Creating markets ▬ Diversification	▬ Market-led modernization	▬ Specialization and increased productivity	▬ Green economy ▬ Supply chain resiliency
Key elements	▬ Import substitution ▬ Infant industry protection ▬ Sector development ▬ Selective opening to competition	▬ Limited government involvement ▬ More horizontal policies ▬ FDI opening ▬ Exposure to competition	▬ Targeted strategies in open economies ▬ Horizontal policies such as improving the business enviroment, SME support, and skills development ▬ Digital development ▬ Participation in global supply chains ▬ FDI promotion with proctection of strategic industries	▬ Support for core technologies ▬ Identification of vulnerabilities ▬ Reshoring production ▬ Acquisition of foregin technology ▬ Entrepreneurship development
Policy enviroment	▬ High policital legitimacy for national development strategies	▬ Low political legitimacy for interventionist strategies ▬ Limitations to policy space through international commitments	▬ Regained legitimacy for national development strategies ▬ Moderate policy space in selected areas	▬ Renewed interest in industrial policy ▬ Reexamination of global norms ▬ Response to climate change, Covid-19 pandemic, Russia's invasion of Ukraine

Source: United Nations Conference on Trade and Development, *World Investment Report 2018* (Geneva: June 2018), https://unctad.org/webflyer/world-investment-report-2018.

East Asia

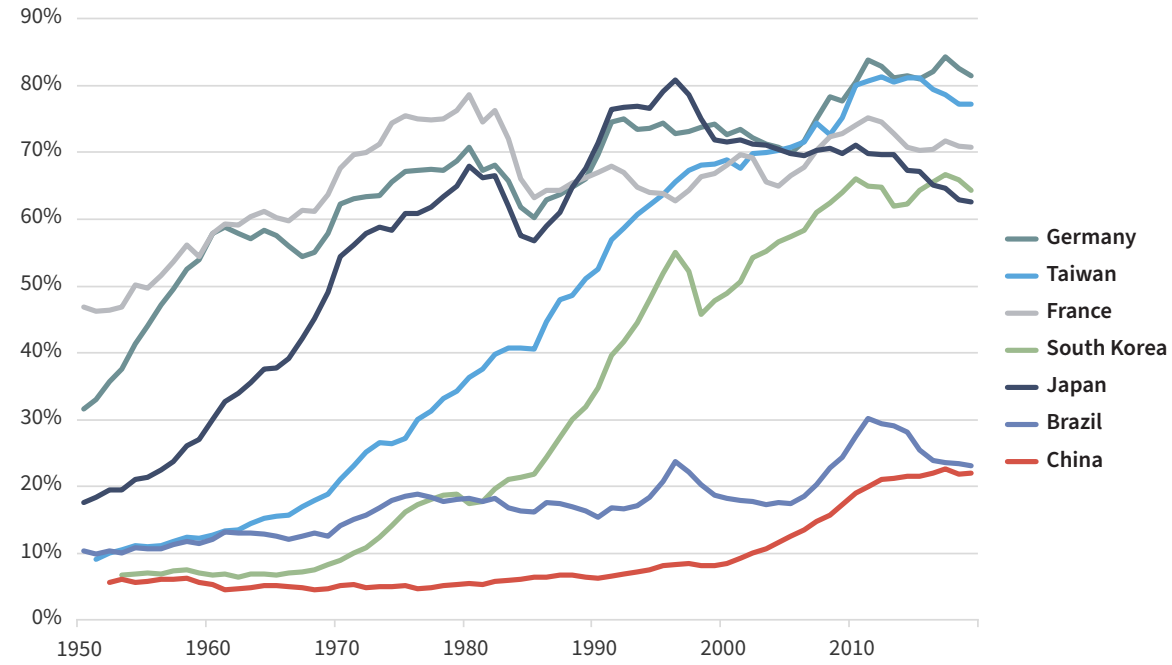
CHINA

China's development and industrial policies are often compared to those of its East Asian peers.[6] The debate over industrial policy is influenced by one striking historical observation: the four "Asian miracle" economies—Hong Kong, Singapore, South Korea, and Taiwan—plus Japan are among the few economies in the postwar era to have gone from low-income or middle-income status to at least 50 percent of U.S. GDP per capita without proximity to Western Europe or natural resource discoveries (see Figure 4.1).[7] The similarities among those Asian economies include an approach to industrial policy

focused on fixing market failures that preclude early domestic producers from emerging, an emphasis on exports rather than import substitution, and encouragement of fierce domestic competition.[8]

Compared to its East Asian peers, China's development is more impressive for its scale than its speed. China's GDP increased from less than 2 percent of the global total in the early 1990s to almost 18 percent in 2021.[9] However, during that period China's average GDP per capita growth rates were lower than its East Asian peers at comparable levels of development.

Figure 4.1: GDP per Capita Compared to the United States, 1950–2019



Note: Based on purchasing power parity exchange rates.

Source: "Penn World Tables (10.0)," University of Groningen, https://www.rug.nl/ggdc/productivity/pwt/?lang=en; and "Expenditures-side real GDP at current PPPs: 2017 Prices," CEIC, https://www.ceicdata.com/en.

China's approach to industrial policy and its advantages are different than its East Asian peers in key ways. First, the Chinese government began its economic reforms with a large degree of control over the entire economy, however inefficient. Second, China was relatively open to and, at least early on, reliant on foreign investment for its industrial development.[10] Third, China has had a larger domestic market than any of its peers for at least the past decade, which allows it to enact policies at scale, affords the government and state sector enormous resources, and entices foreign firms with profits that no other Asian economy can offer. Fourth, China uses some unique industrial policy instruments, especially its government guidance funds (GGFs), the state-owned financial sector, nonfinancial SOEs, and the party-state's political guidance of private firms, as mentioned in Chapter 2.

Finally, Beijing has increased its vertical industrial policies at a level of development when other East Asian economies dialed them back in favor of horizontal reforms.[11] China is continuing or increasing industrial policies at a later stage of development, targeting advanced technologies at the innovation

frontier instead of focusing on "catching up," which had been the focus during peak industrial policy periods for other East Asian economies.

China's industrial policies have not been a constant feature during its development. During the 1990s and early 2000s, China underwent sweeping economic reforms in favor of liberalization. The 9th and 10th Five-Year Plans (1996–2000, 2001–2005) offered only vague guidance. However, Beijing reinvigorated industrial policy, more specifically "techno-industrial policy," and focused on high-tech companies and innovation after 2006.[12]

This began with the Medium- and Long-Term Science and Technology Plan (2006–2020), which introduced the concept of "indigenous innovation" and specific targets for bureaucracies. Soon after, in response to the global financial crisis of 2007–08, China launched a massive stimulus through state sector firms and localities providing funding to back some of its innovation initiatives. At the same time, Chinese economic policymakers soured on the Western "neoliberal" policies believed to have caused the crisis.[13] Subsequently, Beijing announced 16 state-funded "Megaprojects," which were then supplemented by the Strategic Emerging Industries program (2010–2020). Naughton (2021) considers this the true start of China's current industrial policy.[14]

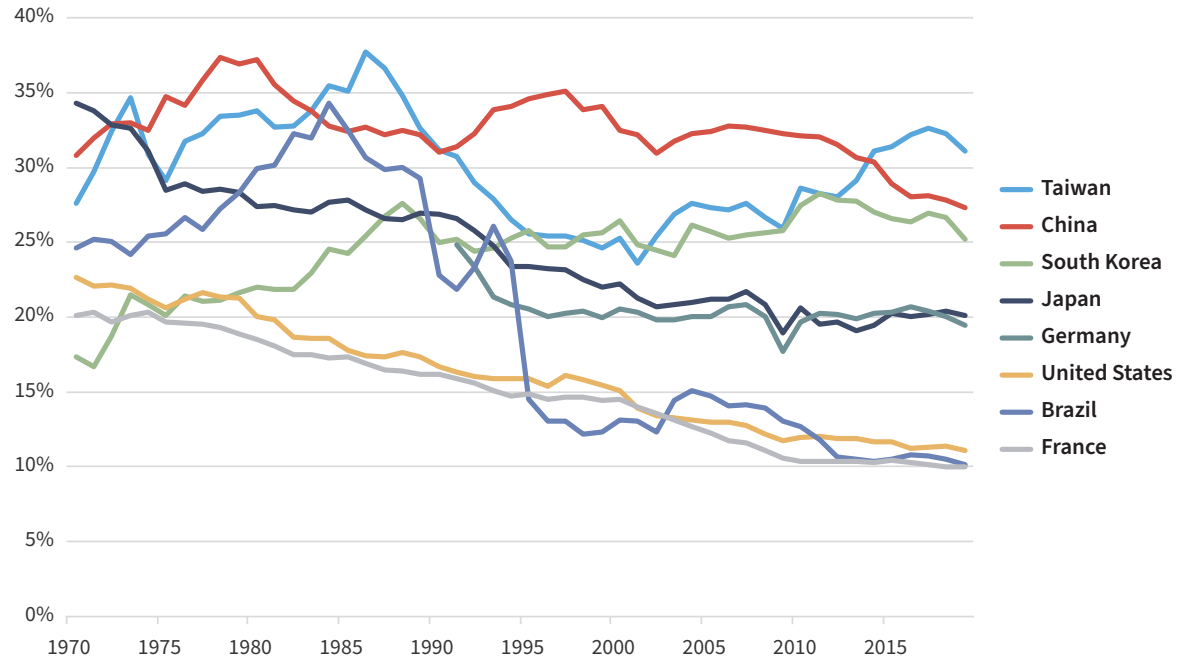
Around 2015, China launched a new set of industrial policy initiatives, including Made in China 2025. This new effort was distinguished by at least two key factors. First, the policies targeted industries at the frontier of innovation, whereas previous projects had been mostly about catching up. Second, China launched most of its GGFs to harness state sector resources while imposing some market discipline, as discussed in Chapter 3.[15] The GGFs support both "national champions," such as the Semiconductor Manufacturing International Corporation (SMIC), and smaller "little giants" in strategic sectors.[16]

Since then, Beijing's emphasis on indigenous innovation has only increased. In 2020, President Xi Jinping announced the concept of the New Development Paradigm, which requires a "dynamic" balancing of internal and external factors with a "high level of self-reliance" as its essence.[17] The 14th Five-Year Plan (2021–2025), while no longer proposing a GDP growth target, focuses on achieving self-sufficiency in core technologies and reducing reliance on foreign technologies and imported resources.[18] The plan calls for deepening the "manufacturing powerhouse strategy" and stabilizing manufacturing's share of the economy.[19]

This latter goal has important macroeconomic and global implications, as it implies that Beijing seeks to achieve high-income status without further expanding the service sector's share of the economy. As incomes rise, a greater share of production goes toward services, as has been the trend in China and elsewhere. The only economy in this study that defied this trend is Taiwan, where manufacturing has grown as a share of the economy since 2000 (see Figure 4.2). But this is because of Taiwan's exports, especially semiconductors.

It is unlikely that a richer China producing more value-added manufacturing would devote a constant share of its spending to consuming those goods. This implies that the rest of the world would need to absorb that additional Chinese manufacturing, which could be a recipe for international trade tensions and an increased focus on China's industrial policies.

Figure 4.2: Manufacturing as a Share of GDP, 1970–2019



Sources: "Productivity Measurement," Asian Productivity Organization, https://www.apo-tokyo.org/wedo/productivity-measurement/; "Manufacturing, value added (% of GDP) - Brazil, France, Germany," World Bank, https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=BR-FR-DE; and "GDP by Value Added," CEIC, Bureau of Economic Analysis, https://www.ceicdata.com/en.

Historical estimates of China's industrial policy spending are sparse, but it is possible to broadly assess how the composition of China's industrial policy spending has changed over time. In the early 2000s, state support through informal or in-kind transfers, especially below-market land transfers, was more important.[20] Since then, formal fiscal mechanisms have grown along with budgets; total government expenditures as a share of GDP increased from 16 percent in 2000 to 33 percent in 2021.[21]

Listed firm data suggests that direct subsidies have steadily increased as a share of GDP since at least 2008, although they stabilized somewhat from 2015 to 2019.[22] Similarly, tax and fee rebates for listed firms have grown since 2010.[23] Since roughly 2014, Beijing has prioritized "financialization" as a policy instrument, with the state as "capital manager" and market-oriented financing through the state-owned financial sector.[24]

Assessing the effectiveness of China's recent industrial policy is difficult because of data limitations and because policy initiatives sometimes take many years to have their full impact. These industrial policies are happening within the context of broader state interventions and geopolitical tensions, which also affect domestic and foreign firms' behavior. For example, Beijing's recent regulatory measures targeting the digital technology sector affect some its largest private tech firms and reaffirm its commitment to high-tech manufacturing over services.[25]

China's approach to industrial policy, its prioritization of specific technologies at the expense of others, and the party-state's broader interventions in the economy are an enormous gamble.[26] China's approach is unique. While other East Asian economies transitioned to lighter-touch policies earlier in

their development, as discussed below, China is pursuing vertical policies at the frontier of innovation while still a middle-income economy.

While other East Asian economies transitioned to lighter-touch policies earlier in their development, as discussed below, China is pursuing vertical policies at the frontier of innovation while still a middle-income economy.

JAPAN

Since the end of World War II, Japan has implemented a series of industrial policies with targeted support to firms, industries, and markets. The name of the primary implementing ministry has changed over time, going from the Ministry of Commerce and Industry (1945–1949), to the Ministry of International Trade and Industry (MITI) (1949–2001), to the Ministry of Economy, Trade, and Industry (METI) (2001–present).[27]

Japan's postwar industrial policy history can be broken down into three phases. From 1945 to 1960, during the reconstruction period, the government directly controlled foreign exchange allocations, regulated market prices and rations, and enforced the Priority Production System to promote the coal and steel industry.[28] From 1960 to 1973, MITI supported strategic industries through measures such as tax advantages, subsidies, preferential financing, and trade protection. During this period, Japan transformed dramatically from agriculture to manufacturing and from light to heavy industries, and the Japanese economy experienced rapid growth.

From 1973 to the 1990s, as oil shocks and inflation hit Japan's economy, the need for public assistance to troubled industries became greater. During this period, foreign criticism began to affect the Japanese government's policy attitudes. MITI became more supportive of free trade and gradually shifted its focus from strategic to corrective policies by providing administrative guidance to key industries, coordinating state-facilitated industry research, and encouraging R&D in the private sector.

After 1991, when Japan's economy entered its period of stagnation, Tokyo's industrial policy shifted from industrial adjustment to structural reform of the economy, with a focus on horizontal R&D. Policymakers' views of industrial policy changed, assessing that state intervention and financing had crowded out private financing and diminished private R&D.[29]

In recent years, Japan has focused on increasing productivity and competitiveness, with a special focus on high-tech industries. Starting in 2009, Japan launched a series of initiatives to diversify the economy, as exemplified by Industrial Structure Vision 2010.[30] In 2017, Japan's Cabinet approved the New Economic Policy Package, which aimed to promote the application of technologies, such as artificial intelligence (AI) and big data, into industries and society.[31]

Recent developments suggest that the Japanese government is increasing its efforts to stimulate innovation. In 2020, Japan's science and technology budget, including local government budgets,

reached a historic high of 9.2 trillion yen ($86 billion).[32] In 2020, as part of Tokyo's stimulus in response to the Covid-19 pandemic, Japan allocated 244 billion yen ($2.3 billion) to help Japanese companies shift production from China to Japan, a reflection of the increasingly geostrategic nature of industrial policy.

SOUTH KOREA

South Korea's first president, Syngman Rhee (in power 1948 to 1960) placed little emphasis on economic policy. Instead, Rhee was largely focused on shoring up his domestic authority and reuniting the peninsula. What little development strategy there was, such as the founding of the Korea Development Bank (KDB) in 1954, emerged largely incidentally and could generously be described as one of import substitution industrialization. Unlike his predecessor, Park Chung-hee (in power 1962 to 1979) prioritized economic development—in part due to fear of overdependence on U.S. aid—and set the country on the path of export-led industrialization. His administration reversed the two marquee policies underpinning the import substitution paradigm: the overvaluation of the Korean won and the ban on trade with Japan. In addition, the Park administration implemented interest rate reform, provided direct subsidies for specific sectors, adopted incentives to encourage the return of overseas talent, and made investments to develop human capital.[33]

With the implementation of the Heavy and Chemical Industry (HCI) Drive in 1973, the Park administration aimed to move Korean firms up the value chain, from light to heavy manufacturing. The government offered subsidized loans, access to industrial parks, favorable tax rates, and other benefits to firms in six strategic sectors: steel, machinery, nonferrous metal, petrochemicals, shipbuilding, and electronics.[34] The government provided support as long as firms agreed to advance ambitious export development plans, which at the macro level aimed to increase the total value of exports to $10 billion by 1981 from $2.5 billion in 1972.[35]

During the HCI Drive's six years, manufacturing saw its share of gross national product (GNP) rise from an average of 16 percent in 1963–73 to 28 percent in 1974–80.[36] South Korea sustained 9 percent GDP growth on average over the duration of the drive. However, the HCI also resulted in high inflation, overcapacity, debt accumulation, and the concentration of economic power in family-run conglomerates (chaebols). With the 1979 oil crisis and ensuing global recession, coupled with the assassination of President Park, the domestic economic situation necessitated a course correction. Beginning in the early 1980s and continuing into the 1990s, successive administrations pursued liberalization to rebalance the economy and gain admission to multilateral bodies such as the OECD and WTO.

A series of developments in the 1990s reduced the state's capacity to conduct industrial policy. Financial liberalization since the 1980s and overleveraged chaebols contributed to the country's sharp downturn after the 1997 Asian financial crisis. The terms of the IMF bailout required deeper restructuring and liberalization of the economy.[37] As a consequence, market forces and regulatory institutions began to play a greater role in South Korea's economy. In addition, repeated presidential corruption scandals soured public opinion toward ties between chaebols and the state, which forced politicians to publicly distance themselves from large firms and diminished the state's capacity to intervene with vertical industrial policies.

Starting under the Kim Dae-jung administration (1998–2003), government support began focusing on emerging companies investing in the information and communications technology (ICT) sector.[38]

These measures led to the creation of the Fund of Funds in 2005, which provides a source of venture capital to SMEs and venture companies through its commitments to partnership funds.[39] The government's support of venture companies investing in new internet, gaming, and communication equipment firms helped expand the sector, although it came short of achieving the rapid growth experienced during the 1970s.[40]

South Korea's industrial priorities were most recently laid out in 2020 by Moon Jae-in's (2017–2022) Korea New Deal, which consists of two components.[41] With the Digital New Deal, the government aims to maintain South Korea's advantage in ICT by promoting digital innovation in the economy. At the same time, the Green New Deal focuses on achieving net-zero emissions and accelerating the national transition toward a low-carbon economy. Many of South Korea's current industrial policies—such as subsidies for environmental technology development, diesel vehicle emission reduction, hydrogen fuel cells, and recycling industry promotion—serve the Korea New Deal's objectives.

TAIWAN

Taiwan's heavy use of industrial policy began under Chiang Ching-kuo, who served as premier from 1972 to 1978 and president from 1978 until his death in 1988. The Chiang administration pursued a bifurcated development strategy. SOEs were tasked with developing Taiwan's heavy industry, while in the innovative industries the government opted to support private firms. Financial support for these private firms was funneled through the Executive Yuan Development Fund, which was established in 1973 and would later be merged with the Sino-American Fund for Economic and Social Development to form the National Development Fund, Taiwan's largest provider of loans and equity investments for firms in strategic sectors.[42] Private firms also received R&D support from government-sponsored research institutions such as the Industrial Technology Research Institute, while industrial clustering was promoted through the establishment of science parks such as the Hsinchu Science Park.

Chiang's efforts to promote industrial exports and competitiveness in high value-added sectors rapidly accelerated manufacturing growth. In the early 1970s, the government began supporting firms in the electronics sector, resulting in the government-backed founding of several major firms, including semiconductor giants United Microelectronics Corporation (UMC) and Taiwan Semiconductor Manufacturing Company (TSMC).[43] During their early stages of development, UMC and TSMC relied extensively on the Taiwanese government for R&D facilities, foreign technology acquisitions, and initial capital investments from both the state and coerced private sector.[44] From 1971 to 1988, the value of Taiwanese manufacturing exports leapt from 75 billion NTD ($2 billion) to 1.67 trillion NTD ($58 billion).[45] For scale, during the same period Taiwan's nominal GDP increased from $7 billion to $126 billion.

Chiang's three immediate successors—Lee Teng-hui (in office 1988–2000), Chen Shui-bian (2000–2008), and Ma Ying-jeou (2008–2016)—maintained the broad contours of his industrial policies, but it appears that outright state spending became less pronounced for innovation and industrial upgrading as Taiwan moved closer to the technological frontier. Likewise, policy guidance and coordination among commercial actors, local authorities, and other economies took on an even greater importance. Since 2016, the Tsai Ing-wen administration has supported established strategic sectors and introduced several new industrial initiatives.

Under Tsai, the National Development Council (NDC)—Taiwan's main economic policy-planning agency and the parent organization to the National Development Fund—began promoting the 5+2

Innovative Industries Program in 2016. The NDC pivoted to advancing the Six Core Strategic Industries in 2020, which includes digital technology, cybersecurity, biotech and medical technologies, national defense, green and renewable energy, and strategic stockpile industries.[46] Taiwanese firms that operate in these industries can receive funding from the Business Angel Investment Program, Industrial Innovation and Transformation Fund, and National Investment Company, all of which are under the umbrella of the National Development Fund.[47]

In addition, Taipei is attempting to incentivize Taiwanese returnees through several state-sponsored action plan programs. The Ministry of Education recently partnered with leading chip makers to set up semiconductor graduate programs at Taiwan's top universities.[48] Finally, the Tsai administration has also complemented its traditional industrial policy instruments by suppressing the New Taiwan dollar's exchange rate to promote industrial exports.[49]

Taiwan's participation in the global economy has been central to raising the island's economic growth over the past several decades. Net exports have increased from 12 percent of GDP in 2011 to 17 percent in 2021.[50] Its success has been undergirded by specializing in the manufacturing of ICT. In the past decade, there has been a substantial expansion of the semiconductor industry, as integrated circuits increased as a share of Taiwan's total exports from 18 percent to 35 percent.[51] TSMC is the world's leading pure-play foundry, manufacturing more than 90 percent of the globe's most advanced chips. It is joined by several other leading manufacturers, with other companies contributing to various elements of the local supply chain. But other governments worry about excessive reliance on TSMC and Taiwan as a whole, concerned that Taiwan could be a potential chokepoint in global technology supply chains. As a result, the future of TSMC and the island's semiconductor industry as a whole, which has benefited from state support, has become a central geopolitical issue.[52]

Europe

The policies of EU member states need to be considered within the European Union's framework. Regulations and market integration ensure that market barriers are low within the bloc. This limits the scope of member-state-level industrial policy, including state aid to targeted firms.[53] Industrial policies within the European Union have occurred in three phases: the interventionist phase (1950–1980), the liberal phase (1980–2005), and the pragmatic phase (since 2005) with targeted but limited sectoral policies.[54]

Some of the most important current industrial policy plans function at the EU level, including the EU Industrial Policy Strategy, adopted in 2019, and targeted initiatives such as the Battery Alliance, launched in 2017, and the proposed EU Chips Act.[55] Similarly, EU-level initiatives fund research and innovation, such as the Horizon 2020 (2014–2020) program and the Horizon Europe program, its successor, which has a budget of €95.5 billion ($100.7 billion) for the period 2021 to 2027.[56]

In response to the Covid-19 pandemic, the European Union launched the NextGenerationEU fund in 2020, worth €750 billion ($857 billion). The initiative includes national recovery and resilience plans submitted by member states, and member states can also make domestic investments in innovation and green technology consistent with EU goals.[57]

FRANCE

France has a rich history of industrial policy, with a strong role for state planning and ownership. France's so-called *dirigiste* strategy was in full force during the postwar period. In 1946, the French government created the General Planning Commission, which began "indicative planning" and produced five-year plans until the 1990s.[58] This involved substantial state ownership of national champions, state-led industrial modernization, and the suppression of labor to support industrial investments. The state funded large R&D programs in strategic sectors and subsidized firms. After the tumult of 1968, political priorities shifted toward protecting workers and struggling companies.[59]

French industry experienced two waves of nationalization. After World War II, France nationalized key private firms in the financial, energy, utility, and transport sectors.[60] In 1981, under a socialist government vowing to enact a "real industrial policy," Paris nationalized 12 industrial conglomerates and 38 banks.[61]

After 1983, with subsidies draining resources without an improvement in industrial performance, the *dirigiste* model faded in favor of market liberalization in exchange for stronger labor protections and social benefits.[62] Beginning in 1986, France embarked on a series of privatizations, which have continued in recent years.[63] Still, the government remains a major shareholder in many firms. As of 2021, the State Shareholding Agency (APE) held stakes in 83 large companies, valued at €125 billion ($148 billion)—with assets concentrated in the energy and aerospace sectors—and BPIFrance holds stakes in smaller firms.[64]

In 2005, France relaunched industrial policy, with a focus on high-tech sectors. The government sought to create "competitiveness clusters" throughout the country by funding R&D projects that partnered companies with public research institutions.[65] The Agency for Industrial Innovation promoted seven technologies, merging in 2008 with the agency supporting SMEs. In 2013, Paris consolidated its sovereign funds into a single organization, BPIFrance, which focuses on SMEs and entrepreneurship.[66]

In 2013, the New Industrial France initiative was launched in an attempt to restore industrial competitiveness. The initiative was based on nine industrial "solutions," such as the data economy, sustainable cities, and future transport technologies, and included 34 plans.[67] However, industrial policy has been largely defensive, focusing on saving key firms from failure.[68]

Under President Emmanuel Macron, France has focused on industrial competitiveness and the energy transition, including under the auspices of France's €100 billion ($114 billion) Covid-19 recovery plan, 40 percent of which was funded by the European Union.[69] In 2021, Macron unveiled the France 2030 plan, which aims to spend €34 billion ($40 billion) over five years in 10 sectoral objectives.[70]

GERMANY

Germany's political culture and corporativist political economy has long made its policymakers wary of direct interventions in specific industries.[71] Germany's industrial policy has focused on horizontal measures, research, export orientation, and the "social market economy."

German policies have sought to establish links between large firms and SMEs (*Mittlestand*), which are considered central to the industrial system.[72] The country's vocational training system is also well integrated with German industry, ensuring a pipeline of highly specialized workers.[73] Germany also has a long tradition of state-funded research institutions. Since 1949, the Fraunhofer Institutes have

conducted applied research, including for industry, while the Max Plank Institutes conduct basic scientific research.[74]

The government created public or quasi-public banks to finance industrial expansion, most importantly the Kreditanstalt für Wiederaufbau (KfW) in 1948.[75] KfW is a development bank with operations to support SMEs, export finance, international development, and funding for policy objectives such as the energy transition. As of 2019, KfW had total assets of €506 billion ($567 billion) and made €43 billion ($48 billion) in domestic loans that year.[76]

In 1968, the German federal government laid out basic principles for industrial policy, which remain relevant. The principles accept that structural change is required for a dynamic economy and that the government should promote change with a good business environment. However, the state can slow down or speed up adjustment to avoid social hardship and reserves the right to support strategic sectors such as aerospace.[77]

Industrial policy was especially controversial in Germany in the 1980s because of protected legacy sectors such as agriculture, mining, and some services. However, as policymakers focused on preparing industries for integration into the European single market, those subsidies decreased during the decade and sectors were deregulated.[78]

After reunification in 1990, West Germany embarked on an expensive effort to integrate the lower-productivity East German economy, which ultimately entailed transfers worth €500 billion ($535 billion). In terms of industrial policy, the government emphasized privatization and economic aid, including investment incentives, credit support to firms, subsidies for SMEs, and support for research. Throughout the 1990s and early 2000s, the government rejected supporting national champions and focused on macroeconomic and labor reforms, including the "Hartz reforms" to lower Germany's unemployment rates and addressing economic stagnation.[79]

Recent initiatives have focused on digitalization and green energy.[80] In 2011, Germany announced the Industrie 4.0 plan, referring to the "fourth industrial revolution," which aims to facilitate digitalization of industry through research and an organizing platform.[81] In 2019, Berlin proposed the National Industrial Strategy 2030, which suggested promoting national and European champions in response to competition with China. This drew criticism from some economists worried that it was leading Germany to anti-competitive industrial policies.[82]

Like France, Germany has received €25 billion ($30 billion) in funding from the European Union to carry out its approved recovery plan by 2026. EU funding was complemented by state funding which largely focuses on achieving digitalization and climate goals.[83]

UNITED STATES

The U.S. approach to industrial policy since World War II has been more cautious and fragmented than the other economies in this study, except for in national defense. Unlike the other economies in the study, the United States emerged from the war victorious and fully developed. The United States was leading, not catching up, and saw no need for a "developmental state." As a consequence, the United States does not have a national development bank, a large state-owned equity investment fund, national indicative plans, or a ministry of industry, apart from some related functions in the Department of Commerce. U.S. policymakers have generally been wary of "picking winners," especially specific firms, and the term "industrial policy" is often a political liability.[84]

However, proponents of U.S. industrial policy argue that a "hidden" developmental state exists, mostly in the defense sector and in the form of state support for technologies, R&D, and early-stage commercialization in the civilian sector.[85] Government-funded R&D and procurement in defense-related sectors have been a key—often dominant—feature of U.S. industrial policy, leading some to assert that U.S. defense policy and industrial policy are nearly the same thing.[86] From 1946 to 1971, $1.1 trillion of the federal government's $1.5 trillion in purchases were for defense-related uses, including atomic energy and space exploration.[87] In 2020, the Department of Defense spent $139 billion on procurement.[88]

Federal tax incentives for R&D have been a major policy instrument since 1981, when Washington introduced the Research and Experimentation Tax Credit.[89] More broadly, the federal government clearly plays a large role in the U.S. innovation ecosystem. In 2019, federal R&D spending was $134 billion, but the federal government only performed $63 billion of that R&D directly, distributing the remainder of that funding to businesses, higher education, and nonprofit institutions.[90] The OECD estimates that in the same year $28 billion in U.S. business R&D was funded by government sources.[91]

Defense-related research has dominated federal R&D spending, falling from a peak above 80 percent in the 1950s to somewhere between 50 and 60 percent since the mid-1960s. Since 2000, the majority of non-defense R&D has gone to medical research.[92] The federal government has programmed R&D spending for specific technologies, with mixed results, such as for supersonic air transport, communications satellites, the space shuttle, the breeder nuclear reaction, photovoltaics, and synthetic fuels.[93]

U.S. industrial policy can be roughly divided into four periods.[94] In the first period, during the Cold War, the United States funded national security and space programs. In 1957, the Soviet launch of the Sputnik satellite spurred the creation of the Defense Advanced Research Projects Agency (DARPA), which supported not just research but also development and demonstration of new products.[95] By contrast, civilian R&D agencies only focused on early-stage research. The U.S. space program, especially Apollo, was a type of mission-oriented industrial policy, with government procurement as a main instrument.

In the second period, from the 1970s to 1980s, the United States responded to the rising competitive threat from Japanese industry. These policies focused on helping firms cross the "valley of death" from research to commercialization.[96] The Bayh-Dole Act of 1980 gave research universities ownership of discoveries conducted with federal funding. Washington established the Small Business Innovation Research program in 1982 and the Manufacturing Extension Partnership program in 1988.[97] The government helped organize and fund Sematech in 1987, a research consortium of U.S. semiconductor firms to counter Japanese competitors.[98]

In the third period, during the 2000s, the United States supported energy innovation in part to address climate change. This included the formation of Advanced Research Projects Agency-Energy (ARPA-E) under the Department of Energy. ARPA-E's budget is much smaller than DARPA's, however, at $427 million compared to $3.5 billion in fiscal year (FY) 2021.[99]

In the fourth period, during the past decade, Washington has focused on advanced manufacturing. In 2012, the government created 16 manufacturing innovation institutes. This initiative is small, however, with total spending of $488 million in FY 2019.[100]

Most recently, perhaps the beginning of a fifth period, the United States used or plans to use industrial policies in response to the Covid-19 pandemic and competition with China. The United States launched Operation Warp Speed in 2020, a public-private partnership to hasten the development and deployment of Covid-19 vaccines.[101] In 2022, Washington is likely to enact a version of the America COMPETES Act, which increases federal funding for scientific R&D, includes the $52 billion CHIPS Act to support the semiconductor industry, and contains other provisions geared toward competition with China.[102]

BRAZIL

Brazil's experiences with industrial policies are similar to those of other major Latin American economies. Its industrial policies have evolved through at least three phases since the end of World War II.[103] Compared to the "Asian miracle" economies and China, Brazil has had less success, suffering from unfavorable macroeconomic conditions, high domestic costs, and an uncompetitive exchange rate that contributed to deindustrialization.

During the first phase, lasting until the early 1980s, Brazil had a state-led industrialization strategy, which initially included attempts at import substitution. The Latin American debt crisis of the 1980s derailed this approach, as it triggered a fiscal crisis and hyperinflation, which peaked at nearly 3,000 percent in 1990.[104]

During the second phase, after macroeconomic stability and foreign investment returned in the 1990s, Brazil adopted reforms in line with the "Washington Consensus," with an emphasis on trade liberalization, market deregulation, and SOE privatization. The instability of earlier years soured Brazilian politicians to statist interventions. Most policies were horizontal, although Brazil created Sectoral Funds in 1988 to fund investments in science and technology, including in 13 commercial sectors. These funds have dedicated revenue sources protected from fluctuations of the general fiscal budget.[105]

In the early 2000s, industrial policy returned, partially in response to anemic growth.[106] Under President Lula da Silva, Brazil launched the Industrial, Technological, and Trade Policy (2004–2007), which included incentives for strategic sectors.[107] This policy was replaced by the Policy of Productive Development (2008–2010), which included programs to coordinate state and private resources and focused on more sectors. Under President Dilma Rousseff, the *Plano Brasil Major* was in effect (2011–2014), attempting to reduce uncompetitive costs and weaken the exchange rate while also protecting domestic markets.[108] The current president since 2019, Jair Bolsonaro, has not continued his predecessors' industrial policies.[109]

The Brazilian Development Bank (BNDES) has been an important and near constant feature of the country's industrial policy. Founded in 1952, BNDES was central to financing Brazil's industrial sectors from the 1950s to the 1980s. In the 1990s, the BNDES led "strategic privatizations" to create national champions while retaining some state control through large minority stakes in its investment fund. Many innovation or industrial programs are managed in conjunction with the BNDES.[110] It is the largest development bank in Latin America and the fifth-largest national development bank in the world.[111] In 2019, BNDES had total assets of 740 billion real ($188 billion), accounting for 8 percent of total commercial banking assets in Brazil in 2019.[112]

Brazil's industrial policies, especially its support to R&D, have had some success. Brazil's R&D expenditure as a share of GDP, while lower than other economies in this study, is above average for Latin America.[113] However, their effectiveness in reviving Brazil's manufacturing sector has been

limited. Manufacturing as a share of Brazil's GDP peaked at 34 percent in 1984 and fell to 12 percent by 1998, after which it only recovered slightly during brief periods.[114]

Part of this might be due to short-term political cycles and a lack of consistency. But a larger part of the issue is likely related to the commodity price boom from 2004 to 2014, which happened to coincide with Brazil's renewed focus on industrial policy.[115] This boosted Brazil's non-manufacturing exports but caused large exchange rate appreciation. From 2004 to 2011, Brazil's real effective exchange rate increased more than 80 percent.[116] This overwhelmed any positive effect the industrial policies might have had on the export competitiveness of Brazil's manufacturing sector.[117]

Furthermore, Brazil's policy implementation in the past decade has been marred by corruption scandals and fiscal shortfalls.[118] For example, Brazil launched a sovereign wealth fund, the Fundo Soberano do Brasil, in 2008 but dissolved it in 2019 because it had been drained to pay off foreign debts.[119] BNDES is divesting large stakes in national champions such as Petrobras to raise funds for the treasury.[120]

Conclusion

Despite variations in industrial policy tools and objectives, the advanced economies in this study generally moved away from vertical policies after approaching the innovation frontier and focused instead on horizontal measures. This may be changing in response to the perceived threat posed by China's industrial policies and other global challenges.

Historical estimates of industrial policy spending are even harder to come by than current estimates. Generally, however, industrial policy spending as a share of GDP probably reached its height during the years of peak industrial policy use. For most economies, this was sometime before the turn away from vertical policies and toward liberalization in the 1980s. In the United States, for example, this would have been during the Cold War, when defense-related expenditures peaked.

China is an outlier. Its industrial policy spending remains high and does not appear to be receding. The composition may have changed, but the scale and ambition of China's industrial policies has only grown. China's uniqueness is not limited to the size of its industrial policy spending (Chapters 2 and 3) or the extent of its sectoral interventions (Chapter 5). China stands out for its increased deployment of industrial policies at its stage of development and in support of specific emerging technologies. Regardless of whether this strategy succeeds, the size of China's economy and its industrial policy spending are likely to increase trade distortions as well as risk more protectionism globally.

5

Filling the Data Gaps with Sectoral Studies

This report's most novel contribution is the estimates of total industrial policy spending in China and seven other major economies at the macro level, as discussed in Chapters 2 and 3. Yet, the aggregate estimates do not include state support through instruments that are unquantifiable at the macro level. Moreover, some kinds of support that are quantifiable may be underestimated or missing because of poor data. Sectoral studies, conducted through micro-level quantitative and qualitative methods, provide more context as to how the states support firms and may help identify areas not captured by the aggregate national estimates.

This chapter provides an overview of three different industries—aluminum, semiconductors, and electric vehicles (EVs)—to highlight the more unique aspects of Chinese state support mechanisms that are missed in the general analysis. All three have been the target of immense support by the central government and localities, yet there are some important differences between them that shape state support. Aluminum is an upstream good and commodity, semiconductors are largely an intermediate good utilized in a variety of products ranging from vehicles to smartphones, and EVs are a final consumer good. In addition, the starting period for these sectors differs. Support for the aluminum sector goes back the furthest, to the 1980s; industrial policy for semiconductors was launched in the mid-1990s; and the state started to focus on the EV sector in 2008–09. The distinctive characteristics of these products, their original historical context, and the development of the sectors over time have affected the extent and type of state support they have received.

Aluminum

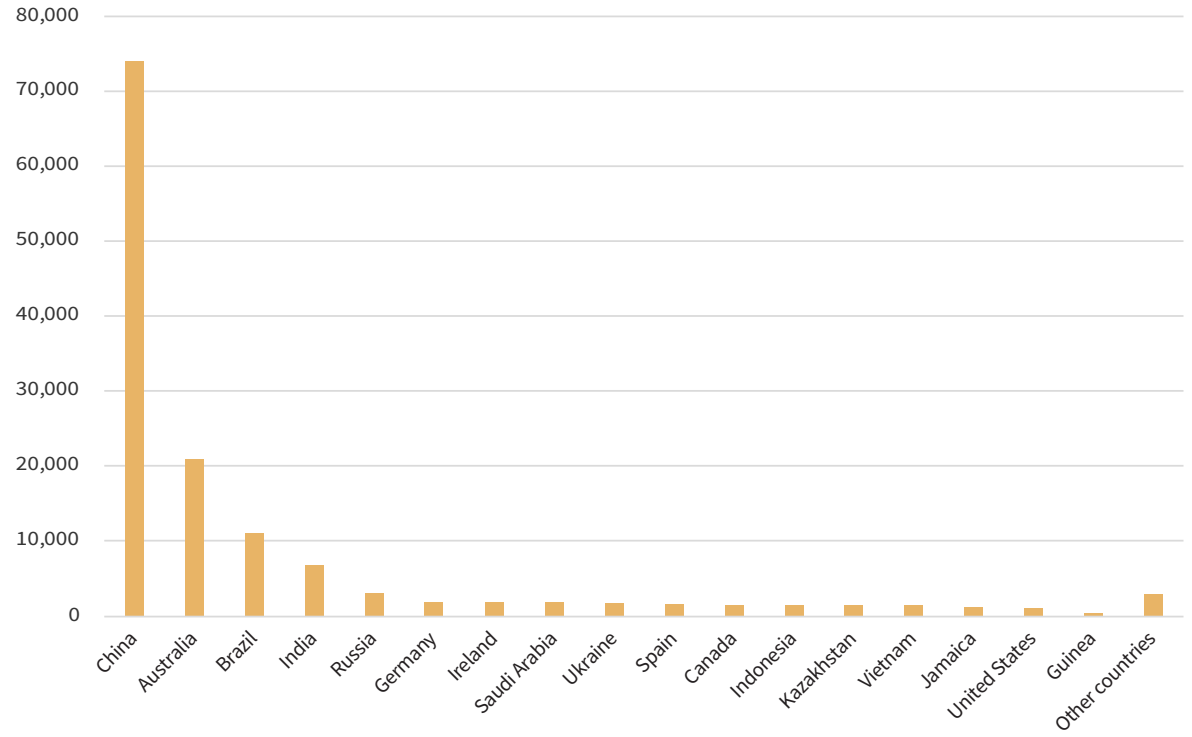
Aluminum is a key component in many production processes, consumer goods, and construction. The aluminum value chain itself has various segments—including upstream (Bauxite mining and alumina

production), midstream (smelting), and downstream (semis fabrication and manufacturing)—that can benefit from distinct industrial policy instruments. State intervention, including state ownership, has been traditionally quite common in the upstream segment of the value chain. But state intervention is increasingly visible in the downstream segment as well, especially because of the growth of Chinese firms and, to a lesser extent, firms operating in the Gulf Cooperation Council countries.

The rapid expansion of China's production over the past two decades highlights the size of the industry and the support received by firms. Between 2011 and 2016 alone, China added more production capacity than the rest of the world combined in the previous 25 years.[1] By 2016, the country accounted for over 50 percent of global alumina production. The expansion was driven by strong state support for state-owned domestic firms through below-market credit and other instruments. This enabled, among other things, the acquisition of foreign technology.[2]

Figure 5.1: Alumina Production Worldwide by Country, 2021

1,000 metric tons



Source: "Mineral Commodity Summaries 2022," U.S. Geological Service, 2022, https://pubs.usgs.gov/periodicals/mcs2022/mcs2022.pdf.

The midstream processing of aluminum is particularly energy intensive. This makes energy one of the costliest inputs in the production of aluminum and one of the areas where state intervention is most common. This study's quantitative estimate excluded energy subsidies where possible unless they were clearly identified as supporting a specific sector or firm. However, while in aggregate energy subsidies in many economies, including China, may be primarily aimed at households, there are sectors where they play a vital role which can only be highlighted through micro-level studies.

As with other commodities, most notably steel, there has been a concern that state support may have led to overproduction, distorting global prices. This was especially controversial in the wake of a slump in prices between 2011 and 2015 which coincided with a relatively profitable period for some Chinese firms, even as much of the global industry struggled.[3] In practice, overcapacity has been difficult to measure because of poor data on firm production and capacity.[4]

Despite multiple WTO disputes focusing on subsidies and overcapacity, an overall industry assessment has been challenging to achieve.[5] To provide more insight into the industry, an OECD study uses firm-level data to evaluate distortions to trade in the aluminum value chain. It found that between 2013 and 2017, states provided as much as $70 billion to companies, with 85 percent of that estimated support going to the top five firms, all of them Chinese.[6] In fact, while most support to non-Chinese firms came in the form of non-financial energy subsidies to multinationals often from various governments, Chinese firms were helped by the Chinese government through a variety of financial and non-financial channels.

Local governments in China provided significant aid to aluminum smelters, including inputs sold at below-market prices, tax exemptions, and cheap land. However, the OECD study found that the largest form of support for Chinese firms came from the state-owned financial sector. The study estimated that companies in its sample benefited as much as $56 billion from below-market credit.[7] There were also instances of firms in the aluminum sector benefiting from debt-to-equity swaps: Hongqiao, a private firm, received an equity injection of 1 billion RMB ($150 million) in 2017 from state-owned investment company CITIC to help lower its debt burden. This meant that the state acquired a 10 percent stake in the company.[8]

There were other forms of support as well, especially through trade measures. The OECD estimates that incomplete VAT rebates and export taxes added up to a de facto tax incentive of well over 15 percent for unrefined Chinese aluminum products between 2013 and 2017. The presence of export barriers makes it harder to export unrefined aluminum. As a result, refined aluminum producers in China benefit from the oversupply and low costs achieved in the upstream segment thanks to state support.

Other countries, including Russia and South Korea, also have similar trade measures in place to incentivize local refining, but they did not benefit from as large a share of the industry or as significant input production capacity as China. The latter was responsible for 20 percent of aluminum semis (a refined aluminum product) globally in 2016, up from about 5 percent a decade prior.[9]

Chinese companies have become increasingly important in the aluminum value chain over the past two decades thanks to extensive state support. Evidence from firm-level data indicates that support provided through the financial system is especially disproportionate in the case of Chinese firms.

Semiconductors

The semiconductor industry has long benefited from state support. For example, the U.S. government spearheaded and helped fund the Sematech research consortium established in the late 1980s.[10] State funding is particularly important because the semiconductor industry is both very R&D intensive and capital intensive, with capital expenditures taking up 30 to 40 percent of semiconductor manufacturers' annual revenues, according to estimates from 2021.[11]

Publicly funded basic research is especially important to the sector. According to some estimates, pre-competitive research—generally basic research conducted by scientists at public and private research institutions and universities—accounts for 15 to 20 percent of all R&D investment in the industry.[12] However, some have noted that clearly disaggregating basic and industrial research is difficult due to increasing convergence between the two due to shorter development cycles.[13] Nonetheless, much of state support has traditionally been focused on supporting R&D. Trends in China suggest this may be changing.

Overall, direct state ownership of firms in the semiconductor industry has been limited outside of China, where the state has been increasing its ownership and control of firms in the sector.[14] According to the OECD, China's National Integrated Circuit (IC) Fund and central SOEs held over 25 percent of ownership for 5 out of the top 10 firms by revenue in China in 2019 in the semiconductor industry. Those numbers are higher when considering state investments in subsidiaries.[15] While ownership per se does not indicate support, the data does show that Chinese firms analyzed in an OECD study received disproportionate government support.

Due to data limitations, it is challenging to estimate overall government support to semiconductor firms at all levels of the supply chain. A research team at the OECD has collected data on a sample of leading listed firms from different countries and involved at various stages of the production cycle, revealing some important patterns in the ownership structure, nationality of firms, and type of support they received between 2014 and 2018.[16]

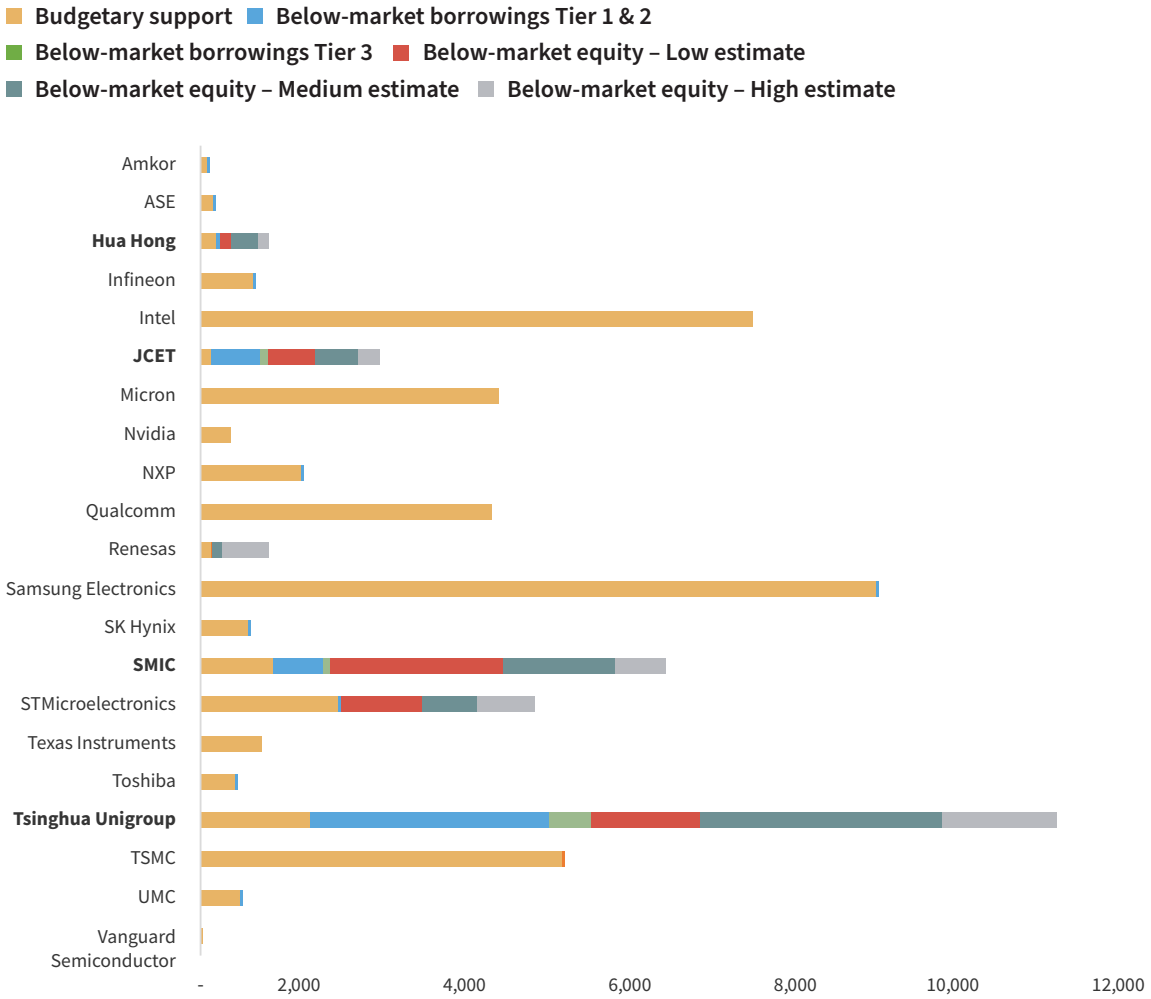
The OECD study breaks down support to firms into budgetary support, below-market credit, and below-market equity. Budgetary support includes R&D, capital expense, and income support (e.g., corporate income tax reductions). This direct support has been common across the board for semiconductor firms. In some cases, such as with R&D tax incentives, the measures may be cross-cutting and target other sectors as well.

It is notable that, as in other sectors, multinationals can and do benefit from budgetary support outside of their home country. In the case of Chinese multinationals, however, most of their funding appears to come from within China. Conversely, none of the firms headquartered outside of mainland China received significant budgetary support from the Chinese state. This reflects the Chinese government's focus on developing a domestic semiconductor industry, which has coincided with an increase in investment in the industry over the past decade.[17]

The OECD's analysis of support through below-market credit and below-market equity for semiconductor firms paints a picture that is consistent with the earlier findings of this report. The level of support provided to Chinese firms through the financial system is far larger than that provided by any other country to non-Chinese firms in the sample, both in dollar value (see Figure 5.2) and as a share of firm revenue (see Figure 5.3).

Support through below-market equity is particularly striking: 86 percent of all below-market equity support identified in the study went to Chinese firms. The only other government-invested firms that obtained below-market equity returns were STMicroelectronics (France and Italy) and, to a lesser extent, Renesas (Japan).

Figure 5.2: Government Support to Selected Semiconductor Firms, 2014–2018
USD, millions



Note: Chinese firms in bold.

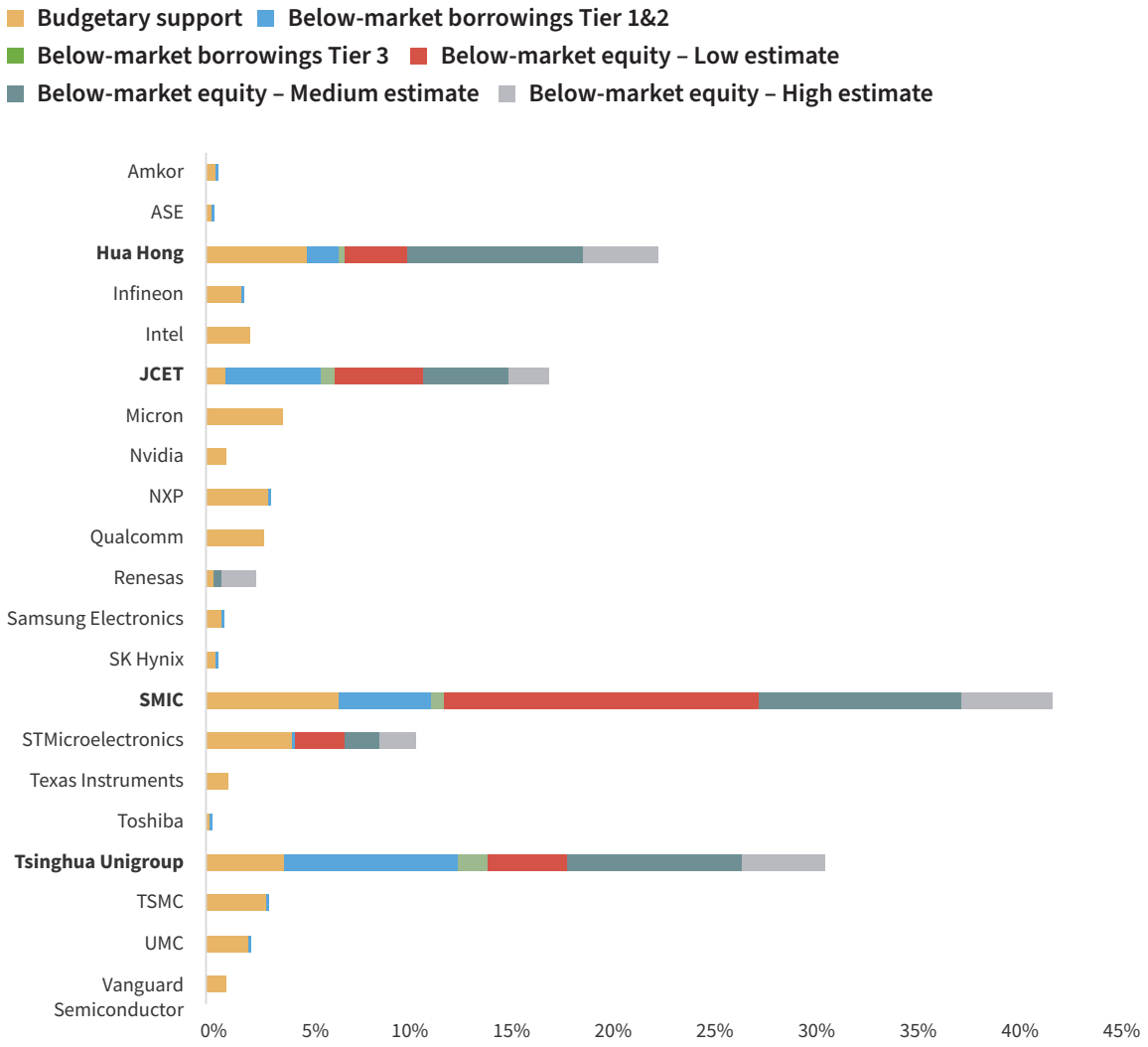
Source: "Measure distortions in international markets: The semiconductor value chain," OECD, Trade Policy Papers No. 234, 2019, 84, doi:10.1787/8fe4491d-en.

Even in the most conservative estimate, the OECD study shows that the deployment of below-market equity is particularly significant for Chinese firms. This reflects the growth of government guidance funds since 2014 (see Chapter 2 for a more detailed discussion) that have heavily invested in the semiconductor industry. In 2021, the size of the National Integrated Circuit Industry Investment Fund (also known as the "Big Fund") and 15 other local integrated circuit funds was estimated at around $73 billion.[18] The Semiconductor Industry Association (SIA) also estimates that government grants, equity investments, and low-interest loans exceeded $50 billion.[19] The OECD notes that the equity injections seem to have financed the construction of new manufacturing facilities, which are growing rapidly. The SIA estimates that 28 new fab construction projects were announced in China in 2021.[20]

While the OECD study only takes into consideration data from 2014 to 2018, it is unlikely that the trends identified for Chinese firms have lessened due to combined political and economic factors

ranging from the U.S.-China competition to spiking demand for semiconductors in consumer products. What might change in the future is the level of support offered to firms from other economies. Already, the United States and the European Union are discussing and enacting new legislation and initiatives to support the semiconductor industry and strengthen domestic supply chains.[21]

Figure 5.3: Government Support to Selected Semiconductor Firms, 2014–2018
% of firm revenue



Note: Chinese firms in bold.

Source: "Measure distortions in international markets," OECD, 84.

Trends in the semiconductor industry suggest that large distortions exist in the industry due to support through budgetary and especially financial instruments, including below-market equity in the case of Chinese firms. But there are other instruments at the disposal of the Chinese government that are harder to quantify. For example, Chinese semiconductor manufacturers benefit from targeted public procurement, and according to a report by the Congressional Research Service, foreign

companies are targeted through discriminatory antitrust practices and trade barriers and pressured to enter joint ventures with local firms.[22]

This analysis is independent from evaluations of the effectiveness of these policies, where evidence is more mixed.[23] More transparency on the volume of state support to firms and more updated estimates would be important in evaluating the direction of state intervention in industry.

Electric Vehicles

By 2020, China was home to nearly half of the global stock of electric passenger vehicles.[I] The country is also a powerhouse in EV manufacturing—most vehicles sold in the country are made domestically.[24]

The growth of EVs in China has coincided with the rise of the New Energy Vehicles sector as a strategic industry listed in Made in China 2025 and the 14th Five-Year Plan (2021–2025).[II] In the past decade, the Chinese government has made a concerted effort to provide supply-side and demand-side subsidies to stimulate the industry. Explicit political support combined with high subsidies has brought a surge in investment, which has led to a fragmented and crowded market. Even the Chinese government has explicitly stated that there is a need to pursue consolidation among EV companies, which are too numerous and small.[25]

Tax breaks and consumer subsidies to stimulate EV sales are not unique to China. For example, Norway has been one of the most active countries worldwide in promoting EVs, with a huge estimated budgetary cost to the state (partially offset by increasing taxes on internal combustion engine vehicles). What makes China's approach notable is that its EV promotion policy was linked explicitly to a strategy of industrial expansion and technological leapfrogging. After 2016, subsidies were increasingly tied to the deployment of more advanced technologies, for example, higher density batteries that allowed for longer ranges. At the same time, the subsidies were directed explicitly toward domestically produced vehicles, excluding, for example, American-made Tesla cars until the opening of the company's first Chinese factory in Shanghai in 2018.

In addition to a sizeable share of consumer subsidies—which are paid out directly to manufacturers rather than consumers—firms benefit from R&D tax credits and a variety of local government support, including tax and land incentives. A high-end estimate for overall government support to the EV industry between 2009 and 2017 totals over 390 billion RMB ($58 billion) (see Figure 5.4).[26] Consumer subsidies have declined significantly in recent years and are scheduled to be phased out altogether by the end of 2022, but they played a pivotal role in the sector in its more immature phase.[27]

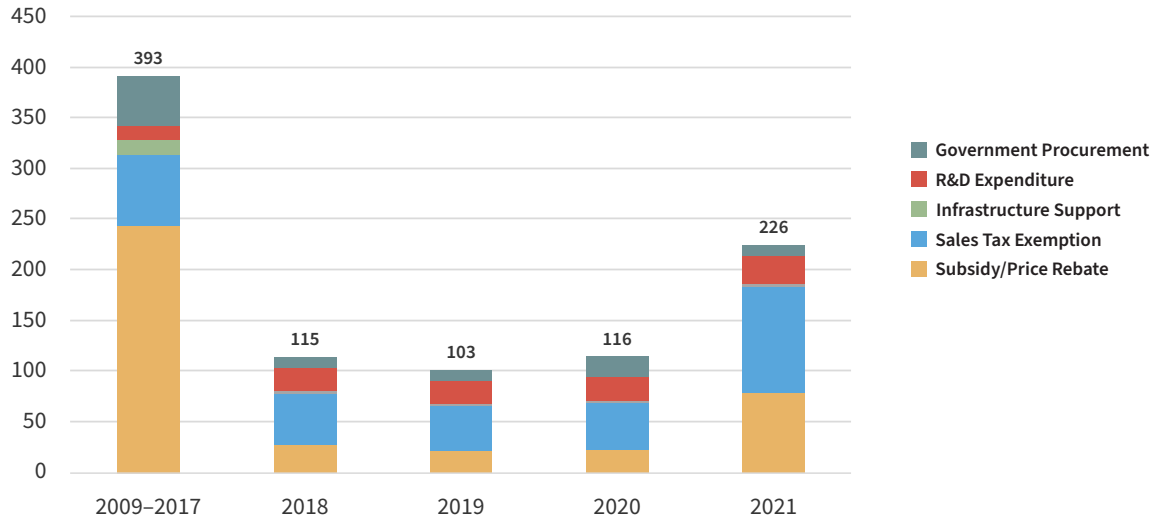
Public procurement also played an important role in helping Chinese manufacturers get off the ground. Through a combination of central government subsidies, directives, and local government entrepreneurship, demand for EVs in public or state-controlled fleets, including SOEs, grew significantly.

I Electric vehicles as used in this work include plug-in hybrid vehicles and battery electric vehicles but exclude hybrid electric vehicles.

II New Energy Vehicles (Xin Nengyuan Qiche) is the official terminology that includes battery electric vehicles, plug-in hybrid electric vehicles, hydrogen fuel cell vehicles. In practice, the NEV sector in China is overwhelmingly focused on the production and sale of battery electric vehicles and to a lesser extend plug-in hybrid electric vehicles. As a consequence this report will use the term EVs and NEVs interchangeably.

One of the main manufacturers to benefit from this was BYD, one of the few companies globally to produce both electric passenger vehicles and electric buses. A forthcoming CSIS report estimates that public procurement of EVs between 2019 and 2021 added up to more than 100 billion RMB ($15 billion).[28]

Figure 5.4: Total Chinese Government Spending on the New Energy Vehicles Sector
RMB, billions



Source: Scott Kennedy, *Beyond Decoupling* (Washington, DC: CSIS, forthcoming).

As mentioned in previous chapters, public procurement is an important tool of industrial policy, but measuring it is difficult. First, there is the challenge of estimating any premium between market prices and those received by firms through state contracts. Second, for companies marketing new and relatively unproven technology, receiving large fleet contracts is a boon. By the time companies such as BYD were expanding their sales to private consumers, they had already benefited from significant experience and financial support through public procurement contracts. For example, Shenzhen's entire bus fleet of over 16,000 buses was electric by 2017, and the fleet of over 21,000 taxis followed suit two years later.[29] These were all largely supplied by BYD, a local company. Considering that the price tag for a BYD electric bus in 2015 was estimated at 1,580,000 RMB ($251,600), this was a significant source of revenue for the company.[30]

The EV industry promotion program also highlights the role of local governments as industrial policy actors. Cities and provinces have played an active role in promoting central government directives, including by piloting new policies such as developing innovative financing systems and promoting car-sharing enterprises. This is a supportive mechanism that can enhance and amplify central government support. In China, it is generally local governments rather than the central government that provide targeted incentives in the forms of tax breaks, cheap land, and direct procurement for mass transit, as well as being directly involved in infrastructure financing and development decisions. This makes it much harder to track and measure the volume of support offered to firms in a systematic manner.

A more recent example of the role of local governments is the high-profile bailout in 2020 of EV start-up NIO arranged by the Hefei government through three local state-owned investment companies that manage government funds. The companies invested 7 billion RMB ($1 billion) to acquire a 24 percent

stake in the company, effectively making the state an important shareholder.[31] This suggests that state investment funds providing below-market equity are becoming more important for EVs, especially as subsidies are declining and local governments are seeking new ways to attract and support firms.

The automotive industry is no stranger to large bailouts by the state worldwide. For example, the U.S. government stepped in to save General Motors and Chrysler in the wake of the global financial crisis, and the French state is a shareholder of several domestic car companies. But the size of China's state investment funds, the unprecedented number of EV companies in the country, and the political incentives of local governments to take a proactive role in supporting strategic industries is notable.

Conclusion

This chapter has relied on sectoral research to provide more context for the findings from Chapters 2 and 3. The three case studies explored state support in different industries and companies operating in various segments of the value chain. What they reveal is that Chinese firms receive more support than other leading firms in the same industries through a combination of quantifiable and unquantifiable instruments.

Chinese firms receive more support than other leading firms in the same industries through a combination of quantifiable and unquantifiable instruments.

Much of the more quantifiable support comes through state-owned banks or investment funds. This is consistent with this study's findings and with historical assessments of Chinese industrial policy that show that central planners are relying on the financial sector extensively to achieve their development goals. But practices such as targeted procurement and import barriers are also deployed to support firms in the aluminum, semiconductor, and EV sectors. Political signaling is also important in directing investment in an economy where the government intervenes dramatically on a regular basis. The evidence at the micro level suggests these practices are widespread across much of the economy even though the study team could not quantify their size. Hence, the macro estimates in this study clearly miss some very important elements of state support.

6

Making the Numbers Matter

What the Data Say

This study's estimates show that China's industrial policy spending is far higher than that of other leading economies, totaling at least 1.73 percent of GDP in 2019, or over $400 billion in purchasing power terms, based on a conservative methodology and limited data. This is higher than China's defense spending in 2019.[1] The next highest spender on industrial policy, as a proportion of their economy, is South Korea, at less than 0.7 percent of GDP. In absolute terms, the United States, with estimated spending of about $84 billion, placed second, but with less than a quarter of China's outlays and less than 0.4 percent of GDP. No matter how one counts—in absolute terms or as a percent of GDP—China's industrial policy spending far surpasses that of any other economy in the sample. Moreover, the calculations were conservative (more about this below), and still, it is not even close. Using different data and assumptions in the calculations, including for China's below-market credit, subsidies to non-listed private firms, government guidance funds, and SOE net payables, would result in an even larger estimate for China.

The macro findings are consistent with evidence from historical overviews of the evolution of industrial policy in each economy and the micro-level sectoral analysis. Historically, China is the only economy in the sample that has maintained or even increased vertical industrial policies as it has approached the innovation frontier. The industry sketches demonstrate that the Chinese state provides Chinese firms in the aluminum, semiconductor, and EV industries highly elevated levels of support through a combination of quantifiable and unquantifiable policy tools.

Anticipating Critiques

This is a data-heavy study, and it is transparent about its sources, assumptions, and calculations. Three kinds of critiques can be expected. The first type will take issue with the estimates for one or another country. Defenders of China will charge that the study intentionally exaggerates China's spending because the project team is anti-China and has authored this study to justify penalizing it. That attack overlooks two things. First, the study is highly conservative in what it includes; it could have adjusted the assumptions and included less easily quantifiable policy tools that other analysts might have included. Instead, the study has excluded such factors due to insufficient data or comparability. And second, data for China were especially hard to obtain. China's economy is the least transparent in this study, so the calculations for China can only partially depend on official data. If China were less opaque and published more data, the results would be different.

At the other end of the spectrum might be those who believe China is so distinctive that it is unfair to engage in the comparison at all and that by doing so the study may be unintentionally normalizing Chinese industrial policy. The challenge with this perspective, though, is that the data assembled here do not show that; rather, they highlight how distinctive China is. Moreover, it is important to subject every economy's situation to analysis and comparison. Economists and policymakers need to base their positions on current reality, not just ideal types of how they think economies should operate.

The second way this report may be challenged is with the argument that the information and analytical obstacles are just too great to come up with any sort of defensible estimates. One reason the kinds of estimates in this report have not been published before is not that no one has thought of them. Others likely saw how difficult it would be to come up with credible numbers and assumed that, without better data, such a study would either miss or miscount things. Although understandable, the project team's view is that the process has been a learning experience and that the numbers, while not perfect, are highly suggestive and can help prompt further research. The project team is willing to run the risk of imperfection in pursuit of practicality.

The final kind of disagreement may come from likeminded analysts who accept the value and practicality of the overall effort but would have made different choices about what tools to include or leave out, how to measure them, or the specific estimates. These are friendly critiques that can only result in further progress.

Reviewing Assumptions

The project team approached this challenge with the best of intentions and believes that the estimates are defensible. However, the potential weaknesses of the data and the effect of making certain assumptions are apparent. This study's objectives are novel, and as a result, it encountered new challenges. Data for China proved the hardest to estimate due to a lack of openness and transparency. No other economy was nearly as opaque as China when it came to budgetary disclosures and the limited self-reporting of subsidies to the WTO.

For the aggregate estimates, the study had to make some assumptions. While accuracy was the goal, some instruments may have been overestimated because of a lack of disaggregated data, such as the composition of the KfW's loan portfolio in Germany and government support for business R&D in France. At the same time, some instruments might be underestimated because of a lack of

comprehensive subnational data. However, these potential inaccuracies do not have much net impact on the overall estimated levels of total spending.

Overall, the estimates for China are doubly conservative, both in terms of the assumptions to estimate policy instruments and in terms of what instruments could be estimated at all. If all policy instruments used by the central and local governments to selectively support sectors could be reliably quantified, the estimate for China would be substantially larger.

The estimates for below-market credit and equity support from state investment funds are the most sensitive to this project's assumptions. In both cases, an implied spread to the value of relevant loans or investments was calculated to estimate the likely subsidy. The methodology for those spreads, however, is uniform, except for the below-market credit estimate for China, discussed below. The variance of interest rate spreads is small across most economies, except for Brazil. For the state investment funds, the same 10 percent spread was used for all economies, including China. Altering that spread would change the share of industrial policy from state investment funds within each economy's total, but it would not change the relative importance of that instrument across the eight economies in this study.

For the China estimate, the most significant methodological difference is the decision to use the borrowing advantage of SOEs to estimate the amount of China's below-market credit. As discussed in Chapter 2, data limitations and the unique nature of China's state-owned banking sector prevented the study from using the same method as the other economies. One could argue that SOEs' credit advantage is not industrial policy, and thus the estimate for China's below-market credit is not comparable to that of other economies. Indeed, total Chinese bank lending to relevant sectors for policy purposes would be a superior metric if it were only possible to estimate. Nonetheless, in the study team's opinion, China's SOEs and their well-known credit advantages are central to China's industrial policy objectives and important for global distortions, meriting inclusion in any estimates.

The final challenge for this study is timing. To obtain a comprehensive number, the study goes back at least three years, to 2019. By doing so, it has not captured unique spending patterns since the start of the Covid-19 pandemic and recent shifts in policy priorities. Regarding Covid-19 spending, for example, the European Union issued a recovery plan of over €800 billion ($946 billion) to be spent by member states, combined with national funds, by 2026.[2] While these are meant to be emergency measures, the size of recovery initiatives is such that it could change the contours of industrial policy in many economies. Furthermore, many governments are openly debating ramping up support for firms to enhance domestic manufacturing and counter competition from China. For example, there are parallel discussions of aid for the semiconductor industry taking place in Washington, Tokyo, and Brussels. Another important recent trend is that of industrial policy deployed in support of decarbonization goals. Green industrial policy can take the form of targeted support for firms. For example, electric mobility promotion accounts for a sizeable share of Covid-19 recovery plans in countries such as Germany and France. Clean tech likely will attract even more government support in coming years.

Supply the Data

An important goal of this report is to advance the conversation about how to calculate a more comprehensive estimate for industrial policy spending for China and other economies. Yet the project

team's view is that whatever progress this report has achieved or is achieved by others in subsequent research, these efforts most assuredly have policy relevance. This does not mean that having these figures will simply be a convenient weapon with which to attack one or another economy. Rather, it may be possible to utilize this approach in a more holistic way that contributes to new norms regarding industrial policy spending. In short, policymakers should take seriously the idea of making the numbers matter.

Perhaps the most important proposal that naturally emerges from this study is that in order to understand spending patterns about industrial policy, such data needs to be systematically collected and shared on a consistent basis. Quite clearly, that is not the case today. This point was driven home in a recent report jointly issued by the world's top multilateral economic organizations.[3] To move forward, two steps should be pursued toward this goal.

1. **Governments and international institutions that govern economic activity need to broaden the scope of tools they use to calculate the total value of industrial policy.** Currently, most of the focus is around fiscal subsidies and, even more narrowly, subsidies that restrict or distort international trade. The WTO's Agreement on Subsidies and Countervailing Measures places attention on "specific" subsidies and leaves untouched a large range of other tools.[4] Some of these, such as government procurement, are covered by other WTO agreements, but the coverage is far from comprehensive, and they are rarely if ever considered together. All the tools analyzed in this study, and potentially others, should be analyzed together.

2. **It is important to require governments to consistently provide more comprehensive and detailed data about the ways in which they support their companies and industries.** Although there are benefits to having the WTO take on this responsibility, which would fall within its purview to monitor its members' policies, this could also be taken up by others, including the G20, the OECD, or the Asia-Pacific Economic Cooperation. Doing so would allow for more consistent comparisons across economies and improve governments' understanding of what state support is truly distortive and harmful to commercial competition. Based on this study, governments should address the following specific data gaps:

    - **Subsidies:** At a minimum, all WTO members should provide estimates of subsidies in their WTO subsidy disclosures, as required by the Agreement on Subsidies and Countervailing Measures.[5] While the degree of compliance is not uniform, all economies in the study provide such estimates—except for China. Beijing lists types of subsidies in its disclosure but does not offer estimates for their values.
    - **Government Expenditures by Type:** All major economies should provide government spending data in accordance with the OECD's Classification of the Functions of Government (COFOG) standards.[6] This makes it easier to estimate subsidies and grants for economic functions. Many governments not in the OECD do not report such data, including China. But even some OECD members do not report at the second level, including the United States.
    - **Government Procurement:** Comprehensive and timely data on government procurement is hard to come by even for many advanced economies. Available data are not reported consistently, including by the type of contract or bidding. There is a general dearth of data that would enable estimates of discriminatory procurement, whether in favor of domestic firms or to support specific industries.[7]

- **Government Funding for Business R&D:** OECD estimates of government spending to support business R&D, while useful, would benefit from more details on what is and is not included in each estimate.
- **Subnational Data:** A common theme across most economies is that subnational government data are less available than central government data. This varies in part by political system. For example, local government industrial policy spending in the United States is harder to quantify because the central government does not oversee subnational spending.
- **Development or Policy Banks:** State-owned or affiliated banks, such as policy banks, development banks, and export credit agencies, are inconsistent in how they report their lending, sometimes even presenting the data differently from one year to the next. Ideally, they would specify sectors, purposes, and their average weighted interest rates or even estimated credit subsidies.
- **State Investment Funds:** Many state-owned investment funds, such as for venture capital, disclose their portfolio companies, but they are less transparent about the value of their shares or the prices at which they purchase them.
- **Tax Benefits for Firms:** Governments are inconsistent in how they report corporate tax expenditures. More data on the value of tax expenditures by sector or program would be beneficial. Ideally, this could be paired with data on headline and average effective corporate tax rates by sector to estimate the aggregate benefit firms receive relative to their tax rates across economies. This would help address concerns that economies with higher overall tax rates appear to have higher tax expenditures for industrial policy.

Alternative Uses of the Data

There are a lot of practical and political obstacles to obtaining widespread agreement and provision of industrial policy spending data by economies around the world. There are many kinds of data that are not collected in any systematic and easily comparable way; others are collected by a range of government and private actors in a fragmented manner that makes comparison difficult; and some of the data that is regularly collected by governmental authorities is often hidden from public view and kept confidential.

If such progress can be made, the subsequent question is equally challenging: How should governments, international organizations, and those interested in supporting a healthy global economy use this data? Although governments and international organizations should put far more effort into obtaining and sharing this data, this project takes no position on how they should be used by policymakers. It is possible, however, to outline potential options and identify their relative strengths and weaknesses.

Generally, there are two variables that could shape how the data are used. One involves the level of interaction among countries: unilateral, bilateral, regional, and multilateral. The other is about the degree to which the data is used as a constraint on participants' behavior, from simply being a source of information that contributes to ongoing discussions to a tool that could be part of a process to impose penalties. Those two variables (level and constraint) yield at least eight possible combinations. Two combinations are worth discussing because they are quite different from each other and together show the range of potential trajectories.

The first option would be for governments to unilaterally use these data in their own analyses as a basis for determining the extent of government intervention in those economies overall and in particular sectors. This could be done without any kind of particular framework beyond a straightforward concern about the extent of distortions created by economic partners. It has long been rumored that the United States has been considering initiating an investigation into the extent of China's subsidies. Other countries could decide to employ the same approach toward China or other trading partners. The kind of data and methodology in this report could be food for thought for such an initiative by any government. Data on industrial policy spending could also be part of an analysis to determine whether a country should be considered a "market economy" or treated as a "non-market economy." There has also been an ongoing debate about whether China should be treated as the latter, not just in the context of trade remedy cases (e.g., antidumping) but in a more general way.[8] Data on overall industrial policy spending could help complement existing analyses on regulatory frameworks, the extent of protectionist policies, and cases from specific sectors.

The advantages of this approach are speed and the presentation of overarching evidence that goes beyond micro data on regulations and cases. The lack of overall data gives economies the space to argue that their own particular measures are no different than data from those accusing them of unfair practices. With general data, charges of hypocrisy may have a harder time sticking. There are at least two potential downsides to employing the data in this way. The first is that it if they are used to justify unilateral penalties, the legitimacy of such sanctions may be more in doubt by the target and other third parties than if they were done through a multilateral process acting as a neutral arbiter. Another problem is that these data could be used by countries to justify raising their own industrial policy spending simply based on the fact that others are spending more than them. Hence, ironically, the data could undermine rather than strengthen norms around market economies and limited state intervention.

At the other end of the spectrum, the data could be used at the multilateral level as a source of information to utilize transparency as a way to encourage not just China but all economies to exert self-restraint in their industrial policy spending. This "name and shame" approach would rely on the reputational costs of being an outlier to incentivize countries to adjust their behavior. The European Commission (EC) offers a potential model. The EC has had a public reporting system in place since 2001, when it began issuing an annual "state aid scoreboard" for each member of the European Union. The state aid scoreboard includes figures, based on data provided by the members themselves, that cover multiple types of spending that support specific firms and sectors and are reported in both absolute value (euros) and as a percentage of GDP. The state aid reported in the scoreboard is allowed under the EU rules. The purpose of the scorecard is to offer a baseline of comparison across the European Union with regard to how fair business climates are and whether state spending achieves its objectives.[9] It is conceivable such an approach could be extended to include a much wider range of countries, in the Indo-Pacific or beyond.

One potential twist on a multilateral transparency initiative would be to set a cap for economies' total industrial policy spending. The most straightforward approach would be a common maximum limit for all economies, most likely established as a certain percentage of GDP. The purpose of a cap would be to trigger an additional review process, not to permit any and all industrial policy spending below the cap or put aside tools to target specific behaviors (such as dumping).

The advantage of a multilateral approach with the aim of transparency is its potential broader acceptance by more economies, which would aid in strengthening the norms—and behavior—around

limited state intervention in the economy. Such a system could potentially evolve over time from one that only expects greater self-reporting to one that utilizes a cap and even could result in penalties for non-compliance.

The downsides, though, are formidable. It has been possible to have a group of likeminded members of the European Union abide by the "state aid scorecard," but it would be much harder to gain participation from China and the full spectrum of economies in the Indo-Pacific or elsewhere. At its Seoul summit in 2010, the G20 considered establishing a maximum cap (the publicly reported figure was 3 percent of GDP) for countries' current account surpluses.[10] It was argued by some that it would be easier to ward off protectionism in the wake of the global financial crisis by setting the cap rather than only having trade authorities go after individual offending measures. The initiative was not adopted due to opposition by China and others. The chances of success now, in a far more contentious environment, on issues even more central to countries' domestic economic governance, are even lower. A firm cap would be even further outside the realm of possibility.

The other challenge to a multilateral transparency approach is how long it would take to get off the ground, the slow pace with which it would be implemented, and the prospect that offending economies would still not change their behavior. The United States, Europe, and market economies in the Indo-Pacific are deeply concerned about the scale and effect of China's current industrial policy spending, and they feel a sense of urgency to act sooner rather than later; transparency may be a useful long-term tool, but it will not resolve today's immediate challenges.

This report offers a rigorous, comparative approach toward collecting, summarizing, and reporting data on industrial policy spending for China and other economies. The next step is for policymakers to determine how best to employ this new information, keeping in mind the potential trade-offs between speed, legitimacy, and effectiveness when responding to China and other countries' industrial policies.

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Scott Kennedy is senior adviser and Trustee Chair in Chinese Business and Economics at the Center for Strategic and International Studies (CSIS). A leading authority on Chinese economic policy, Kennedy has been traveling to China for over 30 years. His specific areas of expertise include industrial policy, technology innovation, business lobbying, U.S.-China commercial relations, and global governance. He is the editor of *China's Uneven High-Tech Drive: Implications for the United States* (CSIS, February 2020) and (with Jude Blanchette) *Chinese State Capitalism: Diagnosis and Prognosis* (CSIS, October 2021) and the author of *The State and the State of the Art on Philanthropy in China* (*Voluntas*, August 2019), *China's Risky Drive into New-Energy Vehicles* (CSIS, November 2018), *The Fat Tech Dragon: Benchmarking China's Innovation Drive* (CSIS, August 2017), and *The Business of Lobbying in China* (Harvard University Press, 2005). He has edited three books, including *Global Governance and China: The Dragon's Learning Curve* (Routledge, 2018). His articles have appeared in a wide array of policy, popular, and academic venues, including the *New York Times, Wall Street Journal, Foreign Affairs, Foreign Policy,* and *China Quarterly*. He is currently finishing a report, *Beyond Decoupling: Maintaining America's Hi-Tech Advantages over China* (CSIS, forthcoming). From 2000 to 2014, Kennedy was a professor at Indiana University (IU), where he established the Research Center for Chinese Politics & Business and was the founding academic director of IU's China Office. Kennedy received his PhD in political science from George Washington University, his MA in China studies from the Johns Hopkins School of Advanced International Studies, and his BA from the University of Virginia.

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Appendix

Sources and Methodology

The appendix contains sources and methodology for estimating industrial policy spending for each economy in alphabetical order.

Instrument	Sources	Description
Brazil		
Direct subsidies	National Treasury of Brazil	Subsidies and grants for relevant sectors in central government budget. Excludes subnational.
Research and development (R&D) tax incentives	Organization for Economic Cooperation and Development (OECD)	Indirect government support through R&D tax incentives.
Government support for R&D	Empresa Brasileira de Pesquisa e Inovação Industrial (EMPRAPII); Financiadora de Estudos e Projetos (FINEP)	Investment from EMBRAPII. Non-reimbursable innovation grants from FINEP. No government-financed business R&D reported in OECD database.
Other tax incentives	World Trade Organization (WTO) Notification on Subsidies	Relevant federal programs from WTO national subsidy notification. Excludes subnational data.
Credit subsidies	Brazilian Development Bank (BNDES); FINEP	BNDES loan portfolio for relevant sectors; BNDES export credit; on-balance sheet innovation loans from FINEP.
State investment funds	BNDES	Equity shareholdings of BNDES. Passive investment. Appreciation in market value is from share appreciation; equity premium marked as zero.

Instrument	Sources	Description
China		
Direct subsidies	Gatley (2019); Garcia-Herrero and Ng (2021)	Listed firm subsidies (private and state-owned enterprises, or SOEs), with SOEs estimated for unlisted economies based on revenues.
R&D tax incentives	OECD	Indirect government support through R&D tax incentives. Data for 2018 estimated from trend. Portion going to large firms subtracted from listed firm tax rebates to avoid double counting.
Government support for R&D	OECD	Government-financed business enterprise R&D expenditure (BERD). Subtracted from direct subsidies to avoid double counting.
Other tax incentives	WIND; OECD	Listed firm reported tax rebates, minus R&D tax incentives going to large firms based on OECD tax database.
Credit subsidies	Gatley (2019), Ministry of Finance	Borrowing advantage for SOEs.
State investment funds	Zero2IPO	Government guidance funds, estimated as three-year average of funds raised because actual investments not reported on annual basis or in the aggregate.
Below-market land sales	WIND	The difference between average market price (auction and bidding) and the negotiated price for total state-owned construction land in China, excluding agricultural land.
SOE net payables	Gatley (2019)	Implied borrowing cost benefit from SOEs' inflated net payables owed to private firms. Likely an underestimate since only counting borrowing costs and not actual annual benefit.
Debt-equity swaps	State Council of China	Implied borrowing cost benefit for SOEs with executed debt-equity swaps.
France		
Direct subsidies	France Stratégie (2021)	Estimate by France Stratégie of French direct subsidies benefiting French industry (excluding R&D support).
R&D tax incentives	OECD	Indirect support through tax incentives.
Government support for R&D	WTO Notification on Subsidies; OECD; EU Commission	Grants listed in WTO subsidy notification. Government-financed BERD from OECD. Horizon 2020 grants; estimated by EU net contribution to for-profit private institutions in France as part of the Horizon 2020 program divided by the numbers of years of the Horizon 2020 program. Likely includes double counting and is an overestimation.
Other tax incentives	France Stratégie (2021)	Estimate by France Stratégie of French government tax incentives benefiting French industry, excluding incentives in the R&D categories.
Credit subsidies	BpiFrance (Banque Publique d'Investissement); European Investment Bank (EIB); Société de Financement Local (SFIL)	BpiFrance medium- and long-term loans and BpiFrance innovation financing aid outstanding balances. Loans from the EIB disbursed in France. BipFrance export credit (outstanding balance) and outstanding loans reported as part of SFIL's export credit loans program.
State investment funds	BPIFrance	BPIFrance investments in 2019.

Instrument	Sources	Description
Germany		
Direct subsidies	Federal Ministry of Finance of Germany	Local and federal grants and subsidies reported by the German Federal Ministry of Finance in the 28th subsidy report under "Trade and industry (excluding transport)."
R&D tax incentives	None	Germany only passed a dedicated R&D tax in 2019, effective in 2020.
Government support for R&D	OECD; Federal Ministry of Finance of Germany; EU Commission	Government-financed BERD. Relevant grants and subsidies reported by the German Federal Ministry of Finance in the 28th subsidy report under "2. Trade and industry (excluding transport)." Horizon 2020 funds (calculated by taking EU net contribution to for-profit private institutions in France as part of the Horizon 2020 program and then dividing it by 7, the years of the Horizon 2020 program). Likely includes double counting and is an overestimation.
Other tax incentives	Federal Ministry of Finance of Germany	Relevant tax revenue shortfall reported by the Ministry of Finance in the 27th subsidy report.
Credit subsidies	KfW Development Bank; KfW International project and export finance (IPEX); EIB.	Outstanding balances reported by KfW for the categories: Loans and Advances to Banks, Loans and Advances to Customers (excluding loans to municipalities). Subtracted funding from KfW to KfW IPEX (consistent with KfW loans to affiliated companies, reported under loans to banks; see note 2 for asset report in KfW annual report). Loans reported by the EIB in Germany. Outstanding loan balance for KfW IPEX (excluding municipal and mortgage loans). Excluded Euler Hermes, which is Germany's official export credit agency, because it only provides guarantees and insurance.
State investment funds	KfW Capital; KfW German Investment Corporation (DEG)	KfW Capital promotional business volume in 2019 (likely overestimated) and KfW DEG equity participations of new commitments in 2019.
Japan		
Direct subsidies	WTO Notification on Subsidies	Relevant subsidies listed in WTO subsidy notification.
R&D tax incentives	OECD	Indirect support through tax incentives and indirect government support through subnational R&D tax incentives.
Government support for R&D	WTO Notification on Subsidies; Ministry of Economy, Trade, Industry (METI); New Energy and Industrial Technology Development Organization (NEDO); OECD	Relevant subsidies from WTO notification, METI industrial tech budget, NEDO funds, and OECD estimate of government-financed business R&D. Likely includes double counting and is an overestimation.
Other tax incentives	Ministry of Finance	Unable to locate detailed tax expenditure or tax revenue shortfall data.
Credit subsidies	Ministry of Finance; Development Bank of Japan (DBJ)	Fiscal Investment Loan Program (FILP) Loans to Corporations; outstanding loans of DBJ.
State investment funds	Japan Bank for International Cooperation (JBIC); Development Bank of Japan (DBJ); Fiscal Investment and Loan Program (FILP)	JBIC equity participations. DBJ investment in corporations. FILP industrial investment.

Instrument	Sources	Description
South Korea		
Direct subsidies	WTO Notification on Subsidies and Countervailing Measures	Relevant subsidies listed in WTO notification.
R&D tax incentives	OECD	Indirect support through tax incentives for R&D.
Government support for R&D	OECD; WTO Notification on Subsidies and Countervailing Measures	OECD government-financed BERD, plus R&D-related grants listed in the WTO notification. Likely includes double counting and may be an overestimation.
Other tax incentives	2019 Tax Expenditure Report, Korean National Assembly Budget Office	Related taxes reported in the Korean National Assembly Budget Office budget document for tax expenditures for "industry, SME, and energy."
Credit subsidies	Korean Development Bank (KDB) 2019 Annual Report; Industrial Bank of Korea (IBK); Korea Eximbank	KDB corporate loans. IBK corporate loans to large firms. Export loans from Korea Eximbank.
State investment funds	KDB; Korea Venture Investment Corporation (KVIC); IBK; OECD	KDB indirect investment volume for 2019 (includes VC, PE); IBK Changgong investment volume. KVIC Fund of Funds investment volume estimated from OECD data. Data not located for Korea Science & Technology Holdings; unclear if the KDB and Funds of Funds data fully captures the funding for KVIC's other funds.
Taiwan		
Direct subsidies	WTO Notification on Subsidies and Countervailing Measures	No relevant direct subsidies listed in the WTO notification that did not go to support R&D.
R&D tax incentives	WTO Notification on Subsidies and Countervailing Measures	Select tax incentives reported to the WTO.
Government support for R&D	Expenditure report on grants by Industrial Development Bureau, Ministry of Economic Affairs, Small Business Innovation and Research and Development Initiative (SBIR) Approved Grant List, WTO report	Select grants from WTO notification, grants issued to enterprises under the Industrial Upgrading Innovation Platform Guidance, and SBIR grants.
Other tax incentives	WTO Notification on Subsidies and Countervailing Measures	Select tax incentives reported to the WTO.
Credit subsidies	National Development Fund (NDF); Export-Import Bank of the Republic of China (ROC EXIM Bank)	Outstanding loans on NDF and ROC EXIM balance sheets.
State investment funds	National Development Fund (NDF)	The difference in the National Development Fund's long-term investments between the years 2019 and 2018.

Instrument	Sources	Description
United States		
Direct subsidies	Good Jobs First	State and local subsidies and grants from Good Jobs First subsidy tracker. Federal grants counted in R&D.
R&D tax incentives	OECD	Indirect support through tax incentives for R&D, estimated for 2019 based on five-year trend.
Government support for R&D	OECD; Defense Advanced Research Projects Agency (DARPA); Advanced Research Projects Agency – Energy (ARPA-E)	Government-financed BERD. DARPA and ARPA-E budgets included, although this may double count with OECD data.
Other tax incentives	WTO Subsidy Notification; Good Jobs First	Federal tax concessions from WTO filing. State and local tax incentives from Good Jobs First subsidy tracker.
Credit subsidies	International Development Finance Corporation (DFC); Export-Import Bank of the United States (EXIM)	DFC and EXIM credit or loan net receivables.

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Chapter 5: Filling the Data Gaps with Sectoral Studies

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Chapter 6: Making the Numbers Matter

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