

Countries increasingly seek to reshape their economies by targeting public support to specific firms and sectors. Their motives vary widely but often include an emphasis on developing strategic industries, with a view to raising future productivity and growth and reducing reliance on imports in key sectors such as energy. This chapter leverages theoretical models, empirical data, and case studies to investigate under what conditions such industrial policies are most likely to succeed. Using a stylized model drawn from the infant industry literature, it shows that industrial policies can help onshore production and catch up with the global technology frontier in a sector where firms become more efficient the more they produce. But this comes at the cost of higher consumer prices during the catch-up phase and is sensitive to initial conditions such as the size of the technology gap, how quickly firms learn by doing, and market size. Such policies can also incur substantial public expenditure, an important consideration at a time of elevated debt and limited fiscal space in many countries. Empirically, recent industrial policies—mainly a combination of direct support and subsidized financing—are associated with improved outcomes in the targeted sector, but the magnitudes are small. Moreover, such interventions are likely to spill over to other sectors, which is difficult to identify empirically. Use of a multisector quantitative trade model to examine the aggregate policy impact finds that imperfect targeting of interventions could reduce aggregate productivity as factors of production move from one sector to another. For example, broad-based energy sector subsidies could lessen reliance on fossil fuel imports while reducing productivity in non-energy sectors. Overall, the chapter findings suggest that policymakers should be keenly aware of opportunity costs and trade-offs: While industrial policy can raise production in the targeted sector, this needs to be balanced against other considerations such as fiscal cost, higher

consumer prices, and possible resource misallocation. Appropriate targeting and safeguards, market discipline, and complementary structural reforms are crucial elements of a well-designed industrial policy package.

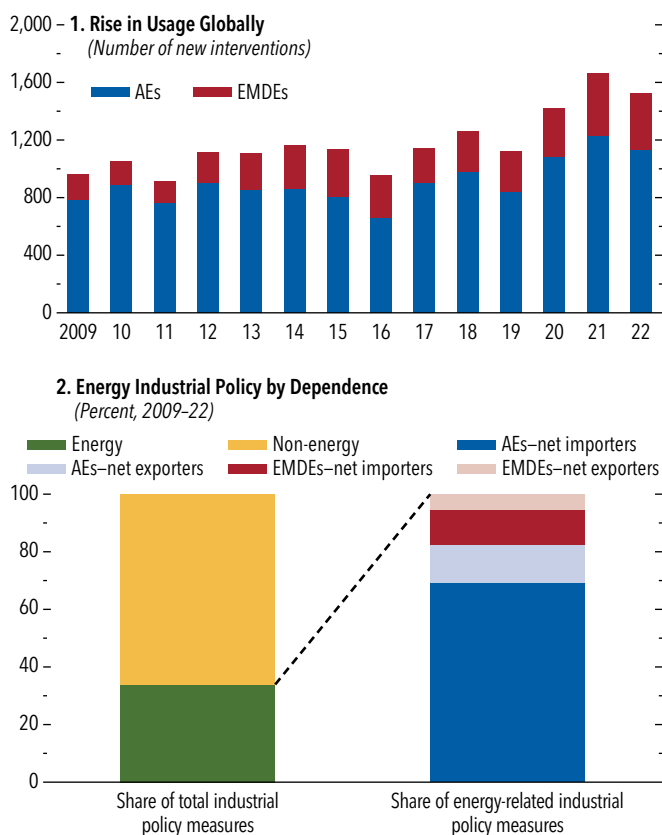
Introduction

The global slowdown in growth, coupled with concerns about disruptions to supply chains and energy security, has prompted renewed interest in policies that enhance growth and resilience, including industrial policy (IP). These interventions look to spur structural transformation by providing public support in the form of subsidies and other preferences to specific industries or firms. The focus on targeting individual businesses or sectors is key; while more general policy measures such as structural reforms and macroeconomic policies can also shape the economy, these would not qualify as IP. In principle, IP can address market failures that constrain the development of production capacity—for example, if costs fall with expanded production at the sector level. In practice, IP takes multiple forms and is used to pursue diverse objectives, including boosting productivity growth, protecting manufacturing jobs, building resilience by creating local supply chains, establishing self-reliance in key sectors such as energy, and diversifying the economy by developing infant industries. The salience of IP as a policy tool has been rising against the backdrop of rising geopolitical tensions.

Since 2009, the number of new IP interventions has increased significantly, with a notable acceleration following the onset of the COVID-19 pandemic (Figure 3.1, panel 1). Nowhere is this more apparent than in the energy sector. A third of all IPs implemented between 2009 and 2022 targeted at least one energy sector product, of which about 80 percent were rolled out in energy-dependent countries (Figure 3.1, panel 2). Several countries have turned to IP to boost energy security by reducing dependence on fossil fuel imports and accelerating electrification of the economy.

Amid the global surge in IP, this chapter provides an analytical framework to analyze the domestic

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Figure 3.1. Global Evolution of Industrial Policies

Sources: Global Trade Alert; Juhász and others 2022, 2025; U.S. Energy Information Administration; and IMF staff calculations.

Note: Industrial policy (IP) is defined as state action directed at changing the structure of the domestic economy, following the text-based approach of Juhász and others (2022, 2025). In panel 1, the bars show the number of new IP interventions introduced by AEs and EMDEs. In panel 2, the first bar shows the share of IP interventions targeting energy-related products, defined as those including at least one energy product at the 6-digit Harmonized System (HS) code level. The second bar breaks down these interventions by countries' energy dependence and income group. Countries are net energy importers (exporters) if their energy consumption exceeds (is less than) production. AEs = advanced economies; EMDEs = emerging market and developing economies.

macroeconomic benefits, risks, and trade-offs associated with such strategies. The analysis focuses on both sector-level and aggregate outcomes, including value added, productivity, and resource allocation, while illustrating economic trade-offs and risks. Throughout, a focus on the energy sector serves both to illustrate general principles and to highlight an important special case of industrial policy. Many countries are striving to reduce dependence on fossil fuel imports by promoting domestic production of clean technology. Moreover, the energy sector has extensive linkages with other sectors, making its performance consequential for the whole economy. To keep the analysis focused and

tractable, the chapter centers on the policy effects of IP on domestic outcomes, as those are likely to be of first-order importance for policymakers.¹

The chapter addresses four main questions:

- *How have industrial policies evolved recently?* What types of industrial policy instruments have been deployed? What are their main stated objectives?
- *What are the main economic justifications for the use of IP? What types of market failures are IPs meant to address?* What kinds of trade-offs do they present, both in theory and in practice? And what are the opportunity costs, in terms of fiscal resources with alternative uses?
- *Empirically, what are the effects of IP on targeted sectors?* How do they differ along key sector and firm characteristics? Do the impacts of policies targeted at the energy sector differ from those rolled out in other sectors?
- *What are the general equilibrium effects of IP?* Does the impact in a given sector spill over to other sectors as resources are reallocated? Can IP distort allocative efficiency and increase misallocation across sectors? Do policies specific to the energy sector deliver better macroeconomic outcomes than policies targeted at other sectors?

To address these questions, the chapter employs an array of empirical analyses, model-based simulations, and case studies. The main findings are as follows:

- *Industrial policies are making a strong comeback.* They are being used to pursue an array of domestic objectives. Recent IPs often take the form of substantial subsidies and aim to achieve multiple domestic objectives—ranging from productivity gains and technological catch-up to job protection and self-sufficiency in key sectors, including energy.

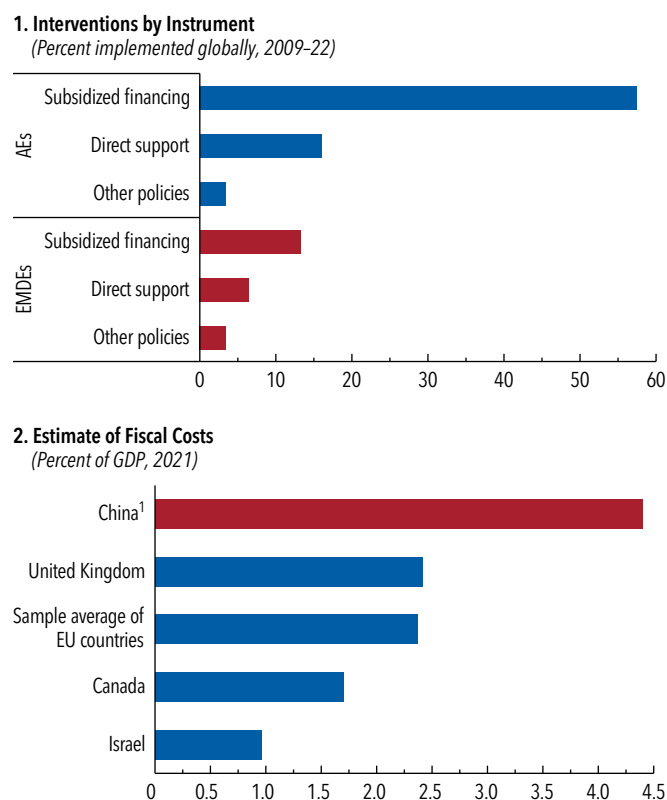
¹Although not the focus of this chapter, large-scale industrial policy can also have cross-country spillovers and trigger retaliation by trading partners. Recent IMF work has found that the domestic effects of industrial policies are sensitive to the subsidies and trade barriers deployed by trading partners (Hodge and others 2024; Rotunno and Ruta 2025) and that recent industrial policies have triggered retaliation (Evenett and others 2024). Theoretical frameworks find that global coordination on industrial policies could improve global outcomes, while retaliation could spark a wasteful global subsidy race (Ju and others 2024; Lashkaripour and Lugovskyy 2023). Box 3.2 finds that, in the EU, national-level subsidies that target local firms can negatively affect competing firms in other European countries. Beyond trade spillovers, Gopinath and others (2025), Graziano and others (2024), and Ruta and Sztajerowska (2025) show that industrial policies can shape cross-border foreign direct investment flows.

- *IP effectiveness is not guaranteed and depends on design, implementation, and broader macroeconomic conditions.* Model simulations and empirical evidence show that IPs can help jump-start domestic industries, especially when productivity scales up with output. But their efficacy is sensitive to sector-specific characteristics that can be hard to determine in advance, such as the rate of learning by doing and potential market size. As shown by case studies of *Korea* and *Brazil*, appropriate targeting, careful implementation, complementary policies, and macroeconomic stability are all keys to success.
- *IPs typically involve trade-offs between competing objectives.* Onshoring production in a strategic sector might lead to higher consumer prices for a prolonged period, and delivering certain IP objectives might require substantial fiscal outlays, which represent an important opportunity cost. For example, fiscal resources could be deployed on high-return structural reforms that do not require granular sectoral information to implement.
- *While IPs can deliver sector-level gains, translating these into broader economic benefits might remain challenging.* Even when sector-level outcomes are positive, IPs can generate negative cross-sector spillovers, drawing away resources from sectors that are not targeted. If those sectors are highly productive, or exhibit economies of scale, then aggregate productivity could fall.

The chapter begins by documenting the recent rise in industrial policies. It then offers a stylized model of infant industry protection, which is used to illustrate the intertemporal trade-offs and risks of IP. A dynamic macroeconomic model with a granular energy sector augments the analysis by examining the trade-offs associated with IP targeting this sector. Case studies illustrate the mechanisms described in the model and add context on supporting frameworks and implementation challenges. Next, the chapter provides empirical evidence that IPs are associated with modest improvements in targeted sectors and that effects vary across countries and sectors. A quantitative trade model shows that IP creates spillovers to untargeted sectors and how this can cause misallocation and reduce aggregate effects. The chapter concludes with implications for policy.²

²The analyses in this chapter reinforce the guidance put forward in recent IMF publications on industrial policy (see for example Chapter 2 of the April 2024 *Fiscal Monitor* and IMF 2024).

Figure 3.2. Industrial Policy Interventions by Instrument and Estimated Fiscal Costs



Sources: Garcia-Macia, Kothari, and Tao 2025; Juhász and others 2022, 2025; Organisation for Economic Co-operation and Development (OECD) 2025; and IMF staff calculations.

Note: Panel 1 highlights the distribution of industrial policies implemented between 2009 and 2022 by instrument used, for AEs and EMDEs. “Subsidized financing” and “direct support” refer to subsidy-based measures. “Other policies” encompasses both tariff and nontariff trade barriers. See Online Annex 3.2 for a detailed breakdown of these policy categories. Panel 2 shows the estimated fiscal costs of industrial policy measures as a share of GDP for selected economies with available data. These costs include support provided through grants, tax expenditures, and financial instruments. The US is not included in panel 2 owing to the lack of comparable fiscal cost estimates. However, available data from the OECD indicate that US fiscal spending on green industrial policies adopted as part of COVID-19 recovery packages amounted to about 3.2 percent of one year’s GDP. EU countries plot the sample average across Denmark, France, Ireland, Italy, The Netherlands, and Sweden. AEs = advanced economies; EMDEs = emerging market and developing economies.

¹China data refer to 2023 and include land subsidies.

The Return of Industrial Policy

The resurgence of industrial policy is marked by a predominance of subsidy-based measures (Figure 3.2, panel 1).³ They comprise subsidized financing—

³Online Annex 3.1 provides references to data sources used throughout the chapter. The stylized facts presented in this section are broadly consistent with the use of alternative algorithms that categorize IP using the Global Trade Alert (GTA) in the recently developed New Industrial Policy Observatory (NIPO) database (Evenett and others, forthcoming). All online annexes are available at www.imf.org/en/Publications/WEO.

subsidies intended to alleviate financial constraints for targeted firms and sectors, such as loan guarantees and interest payment subsidies—and direct support measures, which include transfers such as financial grants and state aid.⁴ In both advanced economies and emerging market and developing economies, subsidized financing and direct support measures accounted for over 80 percent of interventions, with other forms of IP, encompassing tariffs and nontariff measures, playing only a marginal role.⁵

It is inherently difficult to aggregate the total fiscal costs of these subsidies as they entail a wide range of policy instruments, which differ across countries and can be implemented by the central government, through state-owned enterprises (SOEs), or at the local level. Notwithstanding these caveats, available estimates, including new ones for China (Box 3.1), indicate that the fiscal cost of industrial policy is sizable, amounting to a few percentage points of GDP per year (Figure 3.2, panel 2).

Economic Rationale and Motivations

The economic justification for IP is typically grounded in correcting market failures, which prevent an efficient allocation of resources. The analyses in this chapter focus on infant industries, which are at an early stage of development domestically and lag the global technology frontier. If these industries see production costs decline as production increases, a case can be made for targeted public support to facilitate expansion.⁶ While such justifications were historically prominent in emerging market and developing economies, as illustrated by Brazil and Korea in the

1970s, they are increasingly prevalent in advanced economies to support strategic domestic industries that lag the global frontier, such as clean technologies and semiconductors.

In practice, the motivations for IP vary widely and might sometimes overlap. Enhancing competitiveness in strategic sectors emerges as a primary driver of interventions in both advanced economies and emerging market and developing economies (Figure 3.3, panel 1).⁷ In advanced economies, climate mitigation and global value chain resilience also feature prominently among policy objectives. Although noneconomic concerns such as national security and geopolitics appear to be less prominent, it is likely that they drive, at least in part, the underlying motivation for proximate objectives like strategic competitiveness and global value chain resilience (Aiyar and others 2023).

The sectoral breakdown of industrial policy interventions shows that advanced economies target mostly high-tech manufacturing and the energy sector (Figure 3.3, panel 2). In emerging market and developing economies, by contrast, the focus is broader, and interventions are more evenly distributed across high- and low-technology manufacturing, energy, and services.

Energy Independence and Rising Demand for Electricity

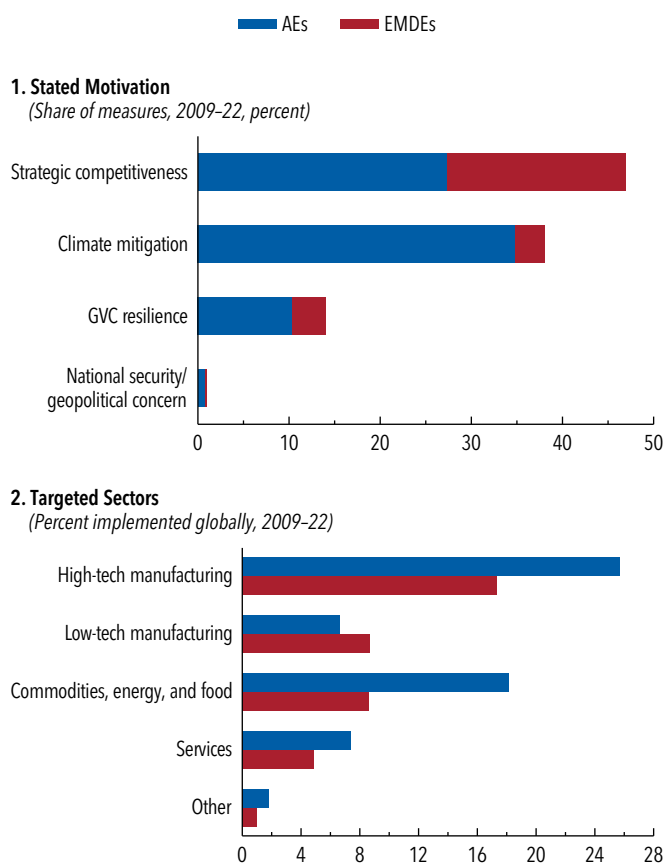
Industrial policies in the past 15 years have targeted energy products to spur a structural transformation of the energy sector, help reduce global greenhouse gas emissions in some countries, boost or diversify energy production in net exporting countries, and promote energy independence. In fact, many net-energy-importing countries rely heavily on fossil fuel imports to meet their energy needs. For example, fossil fuel imports meet more than 80 percent of energy needs in Japan, close to 50 percent in the EU, and about 20 percent in China (Figure 3.4, panel 1). Although importing energy can be a cost-efficient solution in many countries, it is often viewed as

⁴For a more detailed breakdown of the intervention types classified under each of the three policy categories, see Online Annex 3.2. There are no comprehensive data on the fiscal costs attached to each intervention type. In principle, and although this is beyond the scope of this chapter, different instruments could carry different risks, including stemming from the level of public and private sector debt, the availability of credit, financial stability, and governance, including corruption.

⁵However, the use of these other forms of industrial policy has grown at a faster rate in recent years than subsidized financing and direct support measures in advanced economies, based on data available through the end of 2022.

⁶Industrial policy can target other market failures (including those stemming from asymmetric information, collective action, and coordination failures), help kick-start sectors that face high fixed costs (Baquie and others 2025) or relax financial frictions (Itskhoki and Moll 2019). They have also been used to overcome infrastructure gaps, spur diversification (Juhász, Lane, and Rodrik 2023), and target industries with large positive spillovers domestically (Garcia-Macia and Sollaci 2025).

⁷As noted in Evenett and others (2024), a policy's motive is categorized as “strategic competitiveness” if it is aimed at promoting domestic competitiveness or innovation in a strategic product or sector. Strategic sectors include medical equipment, semiconductors, critical minerals, military/civilian dual use, low-carbon technology, and other advanced technologies.

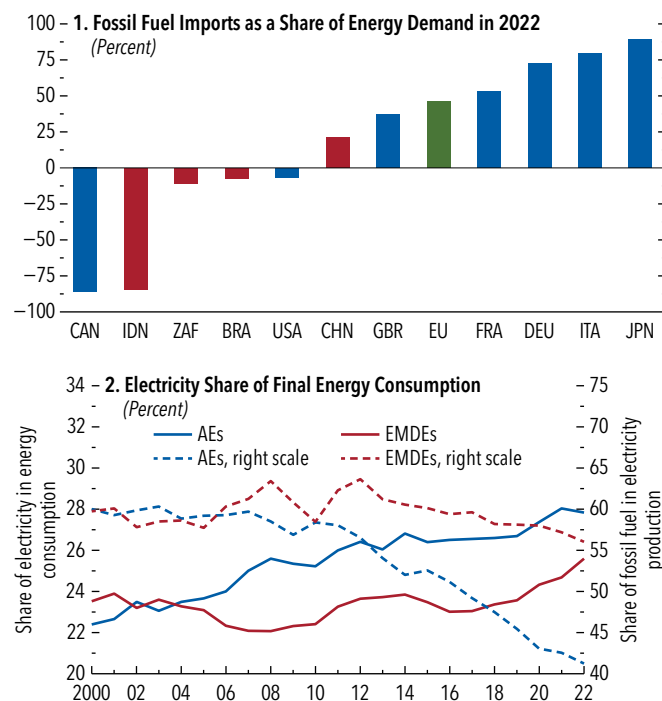
Figure 3.3. Motivation for Industrial Policies and Targeted Sectors

Sources: Evenett and others 2024; Evenett and others, forthcoming; Global Trade Alert; Juhász and others 2022, 2025; and IMF staff calculations.

Note: Industrial policy (IP) is defined as state action directed at changing the structure of the domestic economy, following the text-based approach of Juhász and others (2022, 2025). Panel 1 highlights the stated motivations provided by governments for introducing new IP between 2009 and 2022, based on the subset of measures with available data. Panel 2 shows the distribution of IP interventions by targeted sector in AEs and EMDEs between 2009 and 2022. Sectors are classified according to NACE Rev. 2 (2-digit level). High-technology manufacturing includes computer, electronic, and optical products; electrical equipment; chemical products; pharmaceuticals; basic and fabricated metals; machinery and equipment; and motor vehicles and other transport. Low-tech manufacturing includes wood; paper; printing; textiles; apparel; leather; rubber, plastic, and nonmetallic mineral products; furniture; other manufacturing; and repair. AEs = advanced economies; EMDEs = emerging market and developing economies; GVC = global value chain.

increasing vulnerability to external shocks, posing risks to national security and resilience.

To reduce reliance on fossil fuel imports, policymakers have encouraged substituting key fossil fuel uses with electricity, contributing to a growing share of electricity in final energy consumption (see Figure 3.4, panel 2). In parallel, electricity production itself has become ever less dependent on fossil fuels—particularly in advanced economies (dashed blue line)—with the swift adoption of new technologies

Figure 3.4. Industrial Policy for Energy Security and Increasing Needs for Electricity

Sources: Eurostat; International Energy Agency; U.S. Energy Information Administration; and IMF staff calculations.

Note: Panel 1 plots energy imports over energy demand. Energy demand = production + imports – exports – international marine bunkers – international aviation bunkers +/– stock changes. Fossil fuel includes coal, peat, and oil share; crude, natural gas liquids, and feedstocks; natural gas; and oil products. Fossil fuel imports are measured as net imports, with positive values indicating net importers and negative values indicating net exporters. In panel 2, the sample includes 34 AEs and 27 EMDEs. The lines represent the simple average across countries within each group. Data labels in the figure use International Organization for Standardization (ISO) country codes. AEs = advanced economies; EMDEs = emerging market and developing economies; EU = European Union.

such as renewables. Industrial policy has often been deployed to help develop the domestic manufacturing of clean technologies, often in their infant industry stage, which will be analyzed in a subsequent section. Focus on the power sector has also been motivated by the increasing demand for electricity spurred by the adoption of emerging technologies—including electric vehicles and data centers. By 2030, global electricity demand from data centers and electric vehicles will surpass the current electricity consumption of most countries (Bogmans and others 2025; Online Annex Figure 3.2.2).

Against this backdrop of rising interest in onshoring production in strategic industries, the next section examines the theoretical basis for supporting an industry that currently lags behind the world

technology frontier. It draws from the infant industry literature, which emphasizes potential efficiency gains from supporting a sector in its early stage of domestic development.

Industrial Policy for Infant Industry Protection

A simple stylized model with two countries and sectoral learning-by-doing dynamics serves to illustrate the sector-level benefits countries might seek to capture through IP, the trade-offs involved, and how these depend on countries' starting conditions. The model is grounded in the infant industry protection literature (Harrison and Rodríguez-Clare 2010; Melitz 2005; Redding 1999) and has two key features:

- **Sectoral learning by doing in the infant industry sector:** To capture the potential for catch-up to the global frontier, the model features a young high-tech sector—the infant industry—with learning by doing.⁸ In the infant industry, marginal costs decrease over time with accumulated production experience. This creates a rationale for policy interventions through industrial policies, based on purely economic considerations. The other sector features no learning by doing and captures a composite of more mature industries.⁹
- **Home country lagging the global frontier:** The model features two countries, one of which is the technological leader with greater accumulated production experience and hence lower initial costs. Throughout, the model simulations take the perspective of the technological follower, which is assumed to start at a 30 percent cost disadvantage relative to the leader. This is broadly consistent with the midpoint for cost gaps between technological leaders and followers in studies of infant industry

protection and learning by doing.¹⁰ Moreover, the foreign leader is assumed to have accumulated five times more experience than the home country in the infant industry.¹¹

Industrial policy, consisting of a mix of subsidies and trade protections, can incentivize the onshoring of high-tech production in the home country, but with other attendant dynamic effects. Figure 3.5 compares outcomes for a country that starts behind the global frontier in the infant industry sector across two scenarios: one in which the home country rolls out IP in the sector (solid blue line) and a baseline scenario in which it does not (dashed line).¹²

Under IP, domestic production ramps up more than tenfold because of production subsidies and trade protection. As domestic producers learn by doing, their production costs drop rapidly (Figure 3.5, panels 1 and 2). This comes with two costs. First, even as IP leads domestic production costs to drop significantly over time, consumer prices increase temporarily and remain elevated for a prolonged period (Figure 3.5, panel 3). This occurs because trade protection increases the price consumers face for imported goods, and domestic production costs remain higher than those prevailing at the frontier during the catch-up phase. Second, the subsidy imposes a fiscal cost, which will be explored in more detail later in the chapter.

The conditions under which IP may boost domestic production and enable rapid domestic learning by doing depend, however, on key parameters and initial conditions. Figure 3.6 shows how domestic production costs, production volumes, and consumer prices under the same industrial policy mix compare at the end of the period, depending on key sectoral characteristics in the home country. Results from the previous experiment, in light blue, are compared with results

⁸In the model, the learning-by-doing parameter summarizes how accumulated experience can drive production costs lower over time—for example, as production processes are improved or as workers gain know-how on the factory floor. These improvements are particularly salient at early stages of development in an industry.

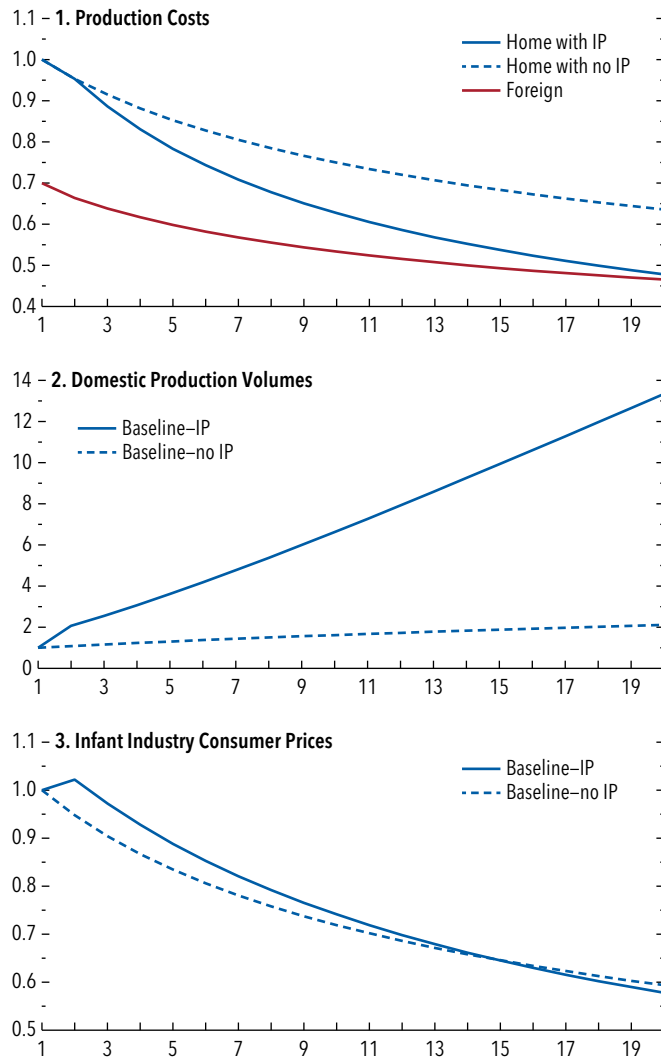
⁹The sectoral learning rate in the high-tech sector is set at 19 percent in the simulations, implying that a doubling of sectoral output leads to a 19 percent decline in marginal costs. This is broadly consistent with observed empirical cost curves and estimates in the academic literature (Barwick and others 2025 for electric vehicles [EVs]) and industry estimates (BNEF 2024). Cooper and Johri (2002) cite 20 percent as the typical learning rate in their literature review, whereas Barwick and others (2025) cite an 8 percent to 30 percent range.

¹⁰For example, Bloomberg New Energy Finance (2024) reports a 30 percent cost gap between China and Europe/US for EV batteries. Regarding historical examples of early-stage industry protection, Luzio and Greenstein (1995) report a 45 percent cost gap between Brazil and the US in microcomputers in the 1980s; Head (1994) reports a 25 percent cost gap between the US and the United Kingdom in the late 1880s in tinplate.

¹¹The analysis uses a fivefold advantage as a midpoint, which is comparable to key examples. For example, in the production of solar panels, China's cumulative experience is about 8–12 times that of the EU and US, while for wind energy equipment, China's cumulative experience is 2–3 times larger (see Online Annex Figure 3.2.3).

¹²The simulations are shown for an industrial policy that consists of a 10 percent tariff and a 12 percent production subsidy imposed by the home country. The industrial policy is financed through lump-sum taxation.

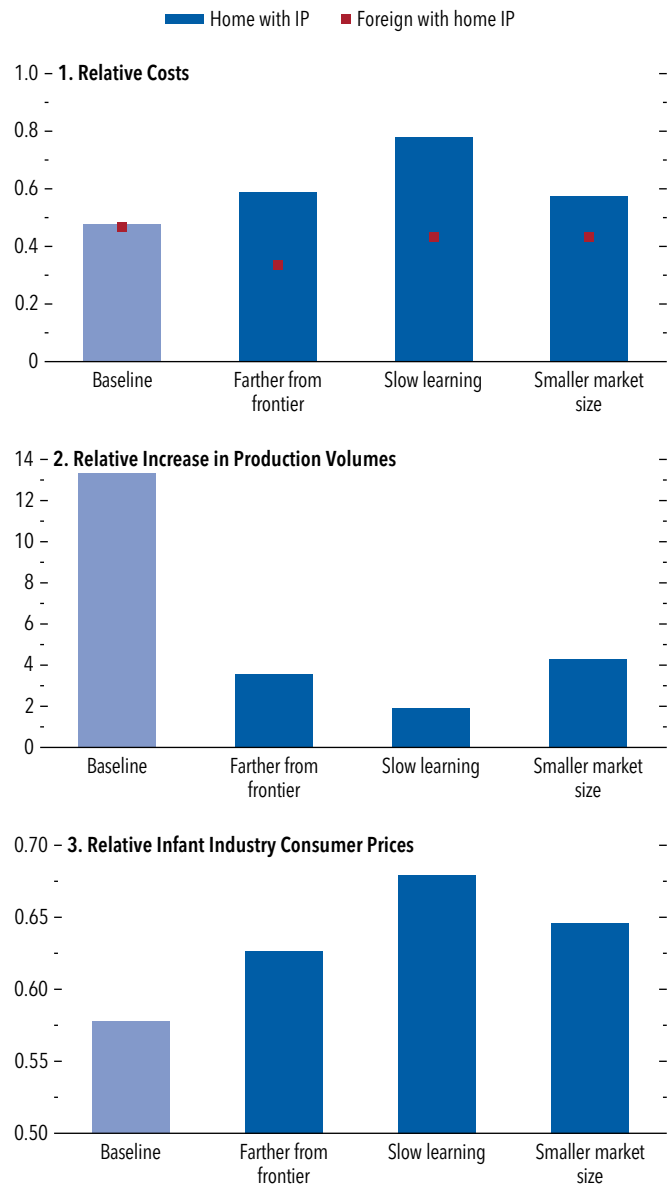
Figure 3.5. Intertemporal Trade-Offs Depend on Learning Rate
(Baseline in period 1 = 1; time on x-axis)



Source: IMF staff calculations.

Note: This figure is a stylized model illustration. Period 1 simulates model outcomes for one period assuming no IPs. Thus, period 1 outcomes are identical across both scenarios. IP scenario assumes that home economy imposes trade protections and production subsidies (12 percent production subsidy and 10 percent tariff) in period 2 and onward. The "no IP" scenario assumes that no IPs are in place from period 1 onward. The learning rate is 19 percent. Normalizations in period 1 are as follows: production costs, production volumes, and consumer prices are each normalized to 1. IP = industrial policy.

Figure 3.6. Key Sector Characteristics Determine the Long-Term Effects of Industrial Policy
(Relative change, baseline in period 1 normalized to 1)



Source: IMF staff calculations.

Note: Bar charts show relative change in costs, production volumes, and consumer prices in period 20 relative to period 1. Each scenario has 12 percent production subsidy and 10 percent tariff. The baseline learning rate is 19 percent, and the baseline cost advantage of the foreign country is 30 percent. In "farther from the frontier" scenario, the foreign country has a 40 percent cost advantage. In the "slow learning rate" scenario, the home learning rate is assumed half as large, and in the "smaller market size" scenario the home country is assumed to have no access to exports. Red squares in panel 1 indicate the relative cost decline in the foreign country in period 20 relative to period 1 if the home country imposes IP. IP = industrial policy.

if the home country either (1) starts farther from the global frontier, (2) experiences a slower learning rate, or (3) faces a smaller market—for example, because it does not have access to export markets.¹³

When IP is conducted further behind the frontier,¹⁴ home production costs decline more slowly as production quantities increase only 3.5 times over the long term. Hence, there is less domestic learning by doing. Instead, the home country continues to rely primarily on imports, even as their prices rise because of trade protections. Since domestic production costs fall more slowly, consumer prices decline less over time.

Public support may not deliver the intended effects if domestic producers cannot learn as fast as anticipated. For example, learning could be slower if shortages of skilled labor limit improvements to production processes or if barriers to the diffusion of foreign knowledge slow technology adoption (Eugster and others 2022). If learning in the home country happens only half as fast as in the foreign country, domestic costs decline more slowly than in the foreign country as production volumes increase. Consequently, instead of catching up to frontier production costs, domestic costs diverge further relative to the technology frontier—remaining 80 percent higher over the long term. Domestic production volumes do not ramp up over time, and consumer prices stay higher for much longer. Hence, domestic consumption also remains more subdued than in the baseline.

Market size is key for industrial policy to deliver production cost declines through learning by doing. In the last counterfactual, the home country is assumed to lack access to export markets. The effectively limited market size now constrains the expansion of domestic production volumes. There is less learning by doing, with production increasing by only about one-third of the increase in the baseline scenario and production costs declining more slowly.

¹³Figure 3.6. shows endpoints after 20 years. The full dynamic paths are in Online Annex Figures 3.3.1.–3.3.4.

¹⁴The literature has discussed the possibility that a country far behind the global frontier may be able to leapfrog the current technological leader (Brezis and others 1991; Lee and Lim 2001; Aghion, Akcigit, and Howitt 2015; Stiglitz 2017). For example, a country might skip a particular technology altogether by moving to deploy mobile phones widely rather than first investing in landline infrastructure. The stylized model in this section focuses on a single technology and does not capture such leapfrogging. However, Online Annex Figure 3.3.1 investigates how countries could get closer to the frontier from the start in a given technology—for instance, by attracting foreign direct investment or technology transfers from the technological leader. In that case, by starting closer to the frontier, the home country could not only catch up to the global frontier but surpass the incumbent technological leader over time.

Finally, it should be noted that the exercise abstracts from the vital complementary role that non-targeted structural policies can play in enhancing productivity. Box 3.3 provides further analysis.

Lessons from Key Industrial Policies, Past and Present

The stylized model of the previous section helped illustrate the dynamic role of IP at the sectoral level and showed how its efficacy is sensitive to many factors. This section seeks to enrich that analysis with greater realism by exploring two key applications. First, a more detailed scenario analysis of energy-security-related IP in Europe, aimed at onshoring clean technology production, is used to illustrate potential trade-offs. Second, two prominent historical cases—Brazil and Korea in the 1970s—are revisited for more granular insights into the appropriate design and implementation of IP and other complementary policies.

Industrial Policy, the Power Sector, and Energy Security

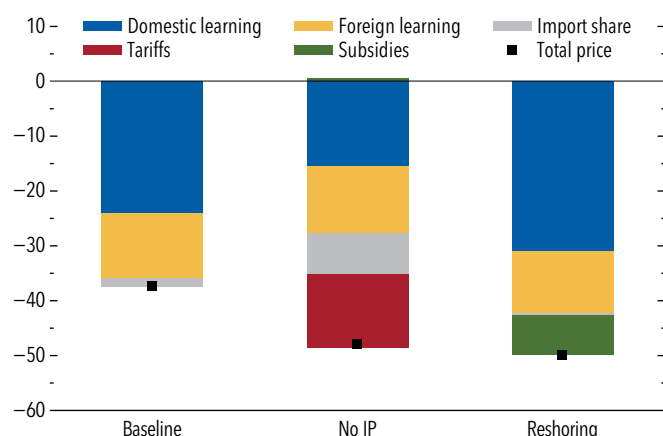
Many countries are seeking to enhance energy security by transitioning to renewable energy and electrifying key sectors such as transportation. This would entail widespread adoption of clean technology equipment, much of which is currently produced in the cost leader, China.¹⁵ IP has been proposed as a way to reshore electric vehicles and renewable power equipment production in the EU and other advanced economies, as these industries are at the infant industry stage. Manufacturing these technologies domestically would increase self-reliance in a critical sector while providing job opportunities. But what are the trade-offs?

To quantify possible trade-offs in the case of the European Union, an extended version of the infant industry model of the previous section is calibrated to clean technology data. It is then augmented with the Global Macroeconomic Model for the Energy Transition (GMMET), a dynamic global model with a granular energy sector representation, to simulate the path of clean technology adoption and sectoral outcomes between 2024 and 2035.¹⁶

¹⁵The literature emphasizes the role of learning-by-doing dynamics in these clean technology industries (see, for example, Bai and others 2020 and Barwick and others 2025).

¹⁶See Online Annex 3.4 for details on the extended version of the model and its calibration.

Figure 3.7. Decomposition of EU Electric Vehicle Price Decline
(Percent change between 2024 and 2035)



Sources: Bloomberg New Energy Finance; International Renewable Energy Agency; and IMF staff calculations.

Note: The figure shows illustrative price change for electric vehicles in the EU under business as usual, and two hypothetical scenarios, derived by a four-country version of the infant industry model, calibrated to current policies, production, and trade patterns of clean technologies. Under baseline scenario, the EU maintains status quo IPs. Under no-IP scenario, all IPs are removed starting in 2025. Under reshoring scenario, a 15 percent production subsidy is introduced in addition to status quo trade protections. EU = European Union; IP = industrial policy.

The model is run under three policy scenarios.

- A *baseline scenario* assumes continuation of industrial policy settings observed in 2024.
- A *no industrial policy (no-IP) scenario* assumes the removal of all existing tariffs and subsidies in the clean tech sector.
- A *reshoring scenario* assumes that major advanced economies increase production subsidies to onshore manufacturing.

Prices, adoption, and onshoring. Learning-by-doing generates a substantial decline in the price of clean technologies in the next decade in the EU, but with varying magnitudes under the three policy scenarios (Figure 3.7). Both the no-IP scenario and the reshoring scenario result in sharper price declines than existing baseline policies. The additional price declines under the no-IP scenario are driven by the removal of existing tariffs, which leads to an increase in low-cost imports. By contrast, if policies observed at the start of the simulation period are maintained (the baseline scenario), the main driver of the decline in prices is the reduction in production costs of domestic firms, which increase production volumes and benefit from learning by doing. These effects are further amplified domestically under the onshoring scenario, as larger subsidies drive a greater increase in production

volumes domestically. However, even as domestic production costs decline substantially, they remain higher than those of the technology leader, which continue to improve over time.¹⁷

Across policy scenarios, the decline in clean technology prices drives uptake (Figure 3.8, panels 1 and 2), particularly under the no-IP and reshoring scenarios, under which price declines are steepest.

A key distinction between scenarios lies in the degree of onshoring of clean technology equipment manufacturing (Figure 3.8, panel 3). Under the baseline, Europe loses domestic market share, as its relatively small market limits the scope for catch-up learning. In the no-IP scenario, the removal of tariffs leads to domestic producers being outcompeted by lower-cost imports. In the reshoring scenario, Europe achieves substantial self-reliance through a combination of subsidies and cumulative learning effects.

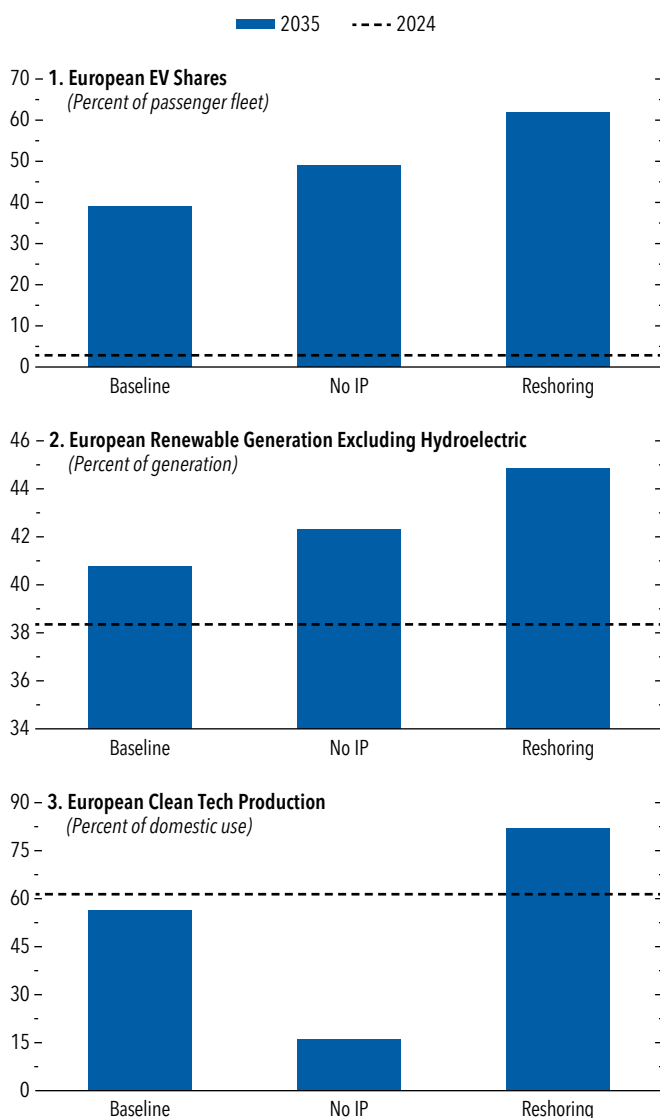
Energy security and macroeconomic effects. The increased penetration of clean technologies leads to a substantial reduction in fossil fuel use in power production and transportation in both the reshoring and no-IP scenarios relative to the baseline.¹⁸ Both policy paths enhance energy security and reduce fossil fuel dependence in the EU (Figure 3.9, panel 1).

But key trade-offs arise as the two scenarios have very different impacts on the labor market and fiscal spending (Figure 3.9, panels 2 and 3). The no-IP scenario eliminates the subsidies present in the baseline but leads to a reduction of employment in clean technology manufacturing of more than 0.5 percent of the labor force as imports dominate. On the other hand, the reshoring scenario results in a reallocation of labor toward clean technology manufacturing, equivalent to more than 1 percent of the labor force. However, these gains are offset by declines in other manufacturing sectors, in part driven by exchange rate movements.

In addition, reshoring entails substantial fiscal costs—estimated at 0.4 percent of EU GDP annually,

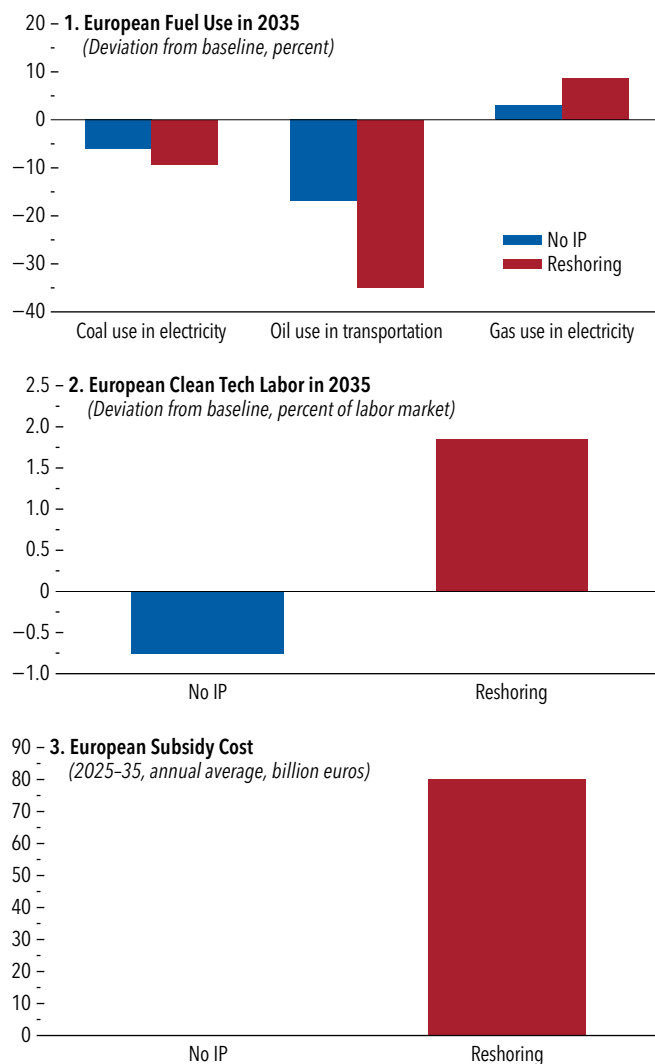
¹⁷The model captures the effects of learning by doing on the production cost of clean technologies. In practice, other factors could lead to divergence in these costs across regions, including access to low-cost inputs, such as critical minerals. Recent literature has demonstrated that a fragmentation of global commodity markets could lead to substantial increases in the price of critical minerals in the EU (Chapter 3 of the October 2023 *World Economic Outlook* and Alvarez and others 2025).

¹⁸By 2035, oil use in passenger transportation declines by 20 to 30 percent relative to the baseline scenario, and coal use in power generation also falls. However, gas use increases because electricity demand is higher and a firming up of capacity is needed to support renewables.

Figure 3.8. No-IP and Reshoring Policies Accelerate Take-Up, but Domestic Production Impacts Differ

Sources: Global Macroeconomic Model for the Energy Transition; and IMF staff calculations.

Note: Under the baseline scenario, the EU continues to impose status quo industrial policies. Under the no-IP scenario, all industrial policies are removed starting in 2025. Under the reshoring scenario, 15 percent electric vehicle and 30 percent renewable production subsidies are introduced starting in 2025. See Online Annex 3.4 for details. EV = electric vehicle; IP = industrial policy.

Figure 3.9. Policy Options to Reduce Fossil Fuel Use through Access to Cheaper Clean Technologies Present Trade-Offs

Sources: Global Macroeconomic Model for the Energy Transition; and IMF staff calculations.

Note: Under the baseline scenario, the EU continues to impose status quo industrial policies. Under the no-IP scenario, all industrial policies are removed starting in 2025. Under the reshoring scenario, 15 percent electric vehicle and 30 percent renewable production subsidies are introduced starting in 2025. In panel 3, the European subsidy cost under the no-IP scenario is zero. See Online Annex 3.4 for details. IP = industrial policy.

or approximately €80 billion in annual subsidies, on average, from 2025 to 2035, equivalent to about €30,000 per job created in the sector. These would amount to close to half of today's EU budget and exceed current agricultural subsidies.¹⁹

Overall, IP could allow Europe to achieve self-reliance in clean technology manufacturing and could protect jobs in the sector, but it would entail large fiscal costs. However, these model results are sensitive to key assumptions. For example, the simulations assume Europe achieves learning rates comparable to those observed in China over the past decade. But this is not guaranteed, and any deviation from this assumption, such as a slower learning rate, would worsen the identified trade-offs, as described in the previous section. Indeed, history shows that IP does not always deliver as intended, as is discussed next.

Historical Case Studies

The stylized model of sectoral industry dynamics suggests that key parameters such as domestic learning rates and market size are important factors to consider for IP. But how have such parameters shaped IP outcomes in practice? And what part do policy design, implementation, and complementary policies play in determining the success of IP?

To shed light on these questions, this section examines two prominent and well-documented historical cases in emerging markets: *Brazil* and *Korea*.²⁰ During the 1970s, the two countries adopted large-scale industrial policies using instruments that resemble those documented in modern industrial strategies, with the aim of promoting structural transformation in selected strategic sectors (Online Annex 3.5). However, their approaches differed markedly. *Brazil* emphasized mainly import-substituting industrialization and relied on state-owned enterprises as the primary implementation vehicle, whereas *Korea* pursued an export-oriented model based on large private business conglomerates

(chaebols).²¹ *Korea's* experience is broadly regarded as more successful—see Ocampo and Porcile (2020) for a comparative perspective, as reflected in higher growth rates of manufacturing value added and real GDP over the period (Online Annex Figure 3.5.1). Recent empirical studies of *Korea's* experience provide causal evidence that IP promoted the expansion of targeted industries, boosted their international competitiveness, and generated positive spillovers to other sectors (Choi and Shim 2024a; Lane 2025). Further analyses show that subsidized firms continued to grow faster than those never subsidized for up to 30 years after the subsidies ended (Choi and Levchenko 2024). However, the literature also contains some dissenting views.²²

Policy design. A comparison of the two countries' experiences reveals the crucial role played by good policy design, elements of which include fostering domestic learning by doing, targeting a sufficiently large market to allow firms to reach an efficient scale of production, and directing support toward areas with high potential returns or positive externalities. In *Korea*, deliberate policies emphasized experiential learning on the factory floor. Chaebols relied on salaried engineers over administrators at the plant level to absorb foreign technologies and build domestic capabilities. In contrast, *Brazil's* IPs were implemented through state-owned enterprises and lacked the private sector engagement that was central to *Korea's* learning-by-doing model (Peres and Primi 2019). The outward-oriented strategy in *Korea* also enabled chaebols to access global markets and benefit from scale economies, whereas

²¹The motivations behind IP in Korea and Brazil also diverged (Ayres and others 2019; De Bolle, Cohen-Setton, and Sarsenbayev 2025; Lane 2025). In Korea, IP was considered essential for military and industrial modernization, as well as for long-term development—in Brazil, a key objective following the 1973 oil crisis was to reduce dependence on oil imports by investing in domestic oil production and alternative energy sources.

²²For instance, Kim, Lee, and Shin (2021) argue that IPs in Korea increased resource misallocation. For Brazil, some commentators are more positive about the country's IP experience. Recent papers suggest that IP may have benefited some sectors that could gain access to large export markets, noting that public support—including the development of an ecosystem of educational and R&D institutions—contributed to Embraer's success in the aeronautics sector as well as to innovation and productivity gains in agriculture (Sabel and others 2012; Veiga and Rios 2019). Indeed, Rodrik (1993) shows that some export incentives introduced under the 1972 Benefícios Fiscais a Programas Especiais de Exportação (BEFIEX) program were effective in boosting Brazil's exports by multinational firms, even though these firms sometimes had to adjust their global strategies by reducing exports to third countries. More recently, Akerman and others (2025) show that public R&D investment significantly increased Brazil's agricultural output, driven by both higher productivity and expanded input use.

¹⁹In principle, these could be financed by the potential revenues from EU carbon pricing over the coming years (Carton and others, forthcoming), which are not modeled in the exercise. If financed through an increase in debt-to-GDP ratios, these subsidies could lead to an initial slight increase in GDP, which later would be offset by a slowdown in activity when debt-to-GDP ratios need to be brought back down (see Online Annex 3.4.5).

²⁰Of course, care should be taken in extrapolating lessons from historical case studies; there are many differences today from the 1970s, including the geopolitical context, trade relations, and global technology.

in *Brazil*, import-substitution confined state-owned enterprises to a limited domestic market, constraining their ability to scale up production volumes. In *Korea*, support was directed toward sectors considered critical for military and industrial modernization and technologically within reach, drawing lessons from Japan's 1958–68 development experience.

Implementation. The two cases underscore the importance of careful implementation, including fostering competition, relying on competent implementing agencies and objective benchmark criteria to evaluate success or failure, and incorporating safeguards—such as sunset clauses—to limit the costs of policy failures. In contrast to the limited competition faced by *Brazil*'s state-owned enterprises, domestic and international competition were central to *Korea*'s approach, helping to ensure market discipline. For example, the government supported multiple firms within sectors and allowed market forces to determine the winners. This approach was evident in the early stages of the automotive industry, when numerous entrants initially competed and benefited from state support, before Hyundai emerged as the dominant firm.²³ IP governance was also institutionalized in *Korea*. Monthly export promotion meetings—chaired by senior officials and involving representatives from academia, finance, and industry—provided a structured forum for oversight and performance review. Export targets served not only as benchmarks for allocating state resources but also as de facto sunset clauses: firms that failed to meet targets risked losing access to state support, regardless of their size or political influence. *Brazil*, by contrast, lacked an IP governance framework and safeguards comparable to *Korea*'s.

Complementary policies. Finally, the cases demonstrate the vital enabling role of structural reforms (see also Box 3.3) and macroeconomic stability. In *Korea*, an anti-corruption campaign launched prior to its industrial policy drive helped to signal that all chaebols were subject to the rule of law. During its industrial push, the government invested in industrial parks and facilitated imports of essential raw materials and capital goods to support domestic production. It also strengthened the education system to meet the growing demand for skilled engineers and production workers.

²³In an advanced economy context, the case of Airbus offers another example of how competition-enhancing industrial policy can succeed in reducing costs in commercial jet manufacturing, boosting R&D and building a pan-European supply chain (Hodge and others 2024).

In *Korea*, land reforms preceded IP, unlike in *Brazil* (de Bolle, Cohen-Setton, and Sarsenbayev 2025). Moreover, in *Brazil*, a fragmented budgeting process, high reliance on external borrowing, and persistent macroeconomic instability—including periods of overvalued exchange rates and accelerating inflation—ultimately culminated in the 1980s external debt crisis and eroded the effectiveness of the country's strategy.

Industrial Policy and Sector Performance

This section estimates the link between IPs and economic performance, both in the targeted sector and in cross-sectoral spillovers via input-output linkages.²⁴

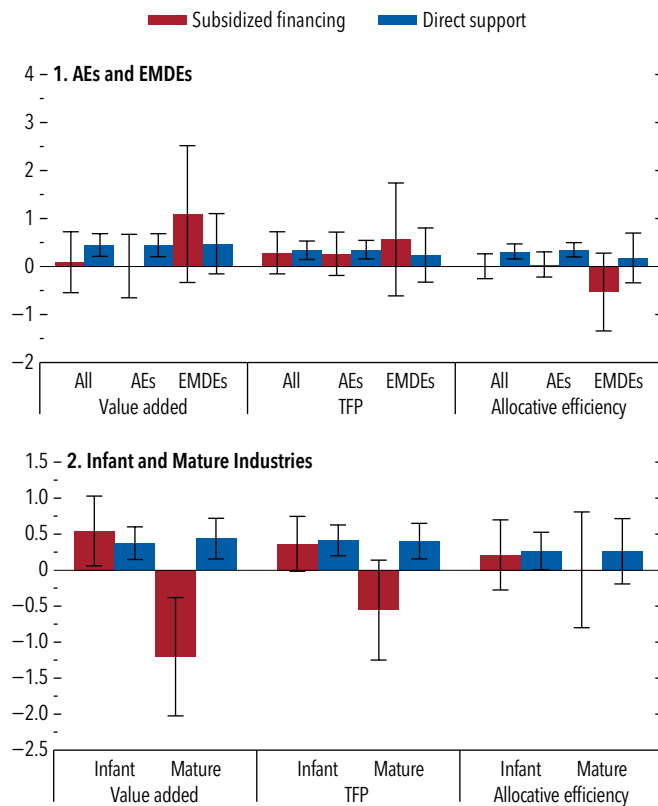
Industrial policies and targeted sector performance. Economic performance improves in targeted sectors, though the magnitudes are small.²⁵ As shown in Figure 3.10, panel 1, direct support IPs are found to improve value added, productivity, and the allocation of resources across firms within industries (allocative efficiency) in line with previous findings (Baquie and others 2025). For subsidized financing, point estimates go in the same direction, but the results are not significant. In terms of magnitudes, one additional direct support measure is associated with about 0.5 percent higher value added and 0.3 percent higher total factor productivity (TFP) in the targeted sector three years after implementation.²⁶ These magnitudes are rela-

²⁴The analysis rests on a local projection method following Baquie and others (2025). It covers 58 countries (including 31 advanced economies) and 732 NACE Revision 2 (4-digit) sectors from 2009 to 2021. The key regressor is the change in the stock of subsidized financing and direct support IPs in a given sector, country, and year, identified by applying the Juhász and others (2022, 2025) algorithm to the Global Trade Alert (GTA) database. Results are broadly consistent with the use of alternative algorithms that categorize IP using the GTA database in the recently developed NIPO database.

²⁵Online Annex 3.6 reports the local projection coefficients for all time horizons before and after the implementation of IPs, thus specifying the full dynamic path. The chapter focuses on the two most prevalent instruments of industrial policy while recognizing that other measures not in the database could also have important economic effects. The main outcome variables, constructed using Orbis data, are sectoral value added, sectoral productivity, and within-sector allocative efficiency, following Hsieh and Klenow (2009). Despite the inclusion of a wide range of fixed effects and controls, a causal analysis is challenged by the endogenous implementation of IPs. For this reason, the results in this section are presented as associations. See Online Annex 3.6 for information on the number of observations for each country, a full description of the methodology, and a summary table with the key findings in this section.

²⁶A new subsidized financing measure (direct support measure) is found for about 12 (6) percent of country-industry observations. Countries that implement new industrial policies implement on average 1.8 (2.0) new subsidized financing (direct support) measures at a time.

Figure 3.10. Industrial Policies and Medium-Term Performance of Targeted Sectors
(Percent)



Sources: Global Trade Alert; Juhász and others 2022, 2025; Orbis; and IMF staff calculations.

Note: The figure estimates the impact of industrial policies (IPs) using the local projection method. The dependent variables are the log difference in sectoral value added, TFP, or allocative efficiency three years after policy implementation. The key right-hand-side variables are the change in the number of subsidized financing and direct support IPs targeting the sector. Regional coefficients are estimated by interacting IPs with a dummy for AEs or EMDEs. Infant/mature industry coefficients are estimated by interacting IPs with a dummy for each industry being infant/mature. In each country, infant industries are industries with above-average share of young and leveraged firms and above-average distance to the world productivity frontier. All specifications control for one lag of dependent and independent variables and include country-sector, country-year, and sector-year fixed effects. Whiskers represent 90 percent confidence intervals. See Online Annex Table 3.6.2 for further details on the data underlying each bar. AEs = advanced economies; EMDEs = emerging market and developing economies; TFP = total factor productivity.

tively small, as industry value added grows on average 6.5 percent and TFP grows about 4 percent per year in the sample. These results reflect higher capital accumulation and employment in the aftermath of subsidy industrial policies (see Online Annex 3.6).

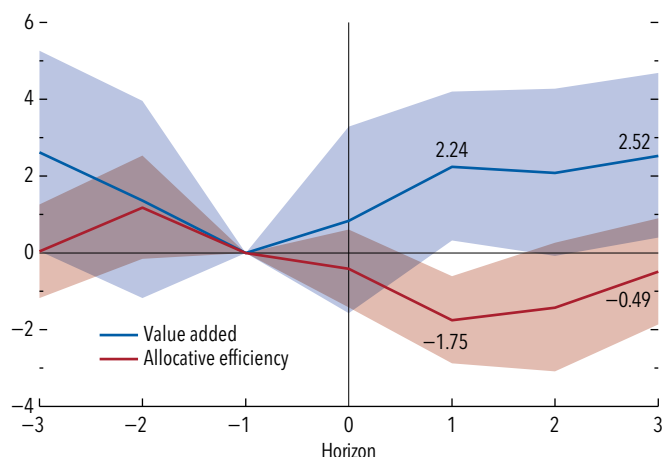
Two findings emerge when investigating whether the relation between IPs and economic performance differs by countries' income level (Figure 3.10, panel 1). First, direct support is associated with medium-term improvements in value added, productivity, and

allocative efficiency in advanced economies, but not in emerging market and developing economies. Second, subsidized financing is associated with a reduction in allocative efficiency in emerging markets—although this is not significant. One additional direct support measure is associated with a 0.3 percent *increase* in allocative efficiency in advanced economies, whereas one additional subsidized financing measure is associated with a 0.5 percent *decrease* in allocative efficiency in emerging market and developing economies (as discussed in greater depth for China in Box 3.1). These findings may reflect the role of complementary horizontal policies, such as reforms to improve governance quality and institutional capacity (Box 3.3), or differences in education, which have been found to be key complements to IPs (Deléchat and others 2024). They may also reflect temporary increases in misallocation as governments incentivize initially small and unproductive firms to scale up production and learn by doing (Kim, Lee, and Shin 2021; Choi and Levchenko 2024). Next, the sample is split into infant and mature industries (Figure 3.10, panel 2).²⁷ This exercise identifies infant industries as industries with a large share of young and financially constrained firms that are relatively close to the world productivity frontier. Direct support appears to have a similar impact across sectors. But subsidized financing appears to benefit only infant industries: The estimates suggest that one additional financial subsidy is linked to a 0.5 percent increase in the value added of infant industries and a 1.2 percent decrease for mature industries three years after the shock. These findings are likely to reflect the importance of financial frictions for the capital accumulation of young and productive firms and industries (Machado Parente and others 2025).

Industrial policies in the energy sector and downstream sector performance. A large share of IPs target energy sectors and can potentially spill over to the rest of the economy because energy is a key factor of production. Estimates suggest that one additional direct support measure is associated with 0.7 percent higher

²⁷These results build on investigation by Baquie and others (2025) of the relationship between industrial policy and targeted sector outcomes along several different sector-specific and firm-specific dimensions. They find, individually, a stronger association between industrial policy and economic outcomes in young firms, as well as in more financially constrained firms. Moreover, they find a stronger association between industrial policy and sectoral value added in sectors with high markups and high external dependence (such as ship building and pharmaceutical products) relative to sectors with low markups and low external dependence (for instance, manufacturing of nonelectric domestic appliances).

Figure 3.11. Downstream Impact of Energy Sector Industrial Policy
(Percent)



Sources: Global Trade Alert; Juhász and others 2022, 2025; Orbis; and IMF staff calculations.

Note: The figure estimates the impact of industrial policies (IPs) using the local projection method. The dependent variables are the log difference in value added and allocative efficiency over the specified horizon. 0 = the short-term horizon corresponding to when industrial policies are introduced; see Online Annex 3.6 for details. The key independent variable is the change in the number of direct support IPs in upstream energy sectors. All specifications control for one lag of dependent and independent variables, for IPs implemented in downstream sectors, and include country-sector, country-year, and sector-year fixed effects. Shaded areas represent 90 percent confidence intervals, and numbers report point estimates.

TFP in the targeted energy sector within a year of policy implementation (Online Annex Figure 3.6.5, panel 1). These productivity improvements spill over to downstream sectors over time as producers purchase energy from more productive suppliers. One additional direct support measure to energy sectors is linked to a 2.5 percent increase in value added for downstream sectors one to three years after the shock (Figure 3.11).²⁸ However, the measure is also linked to a temporary 1.7 percent decrease in allocative efficiency in downstream sectors. These findings could reflect differences across firms in energy cost shares, suggesting that firms benefiting the most from lower energy prices are not necessarily the most productive (Aterido, Iootty, and Melecky 2025; Fontagné, Martin, and Orefice 2024).

Beyond the impact of IP on targeted sectors, there is the wider question of its impact on the overall economy. Cross-sector linkages and spillovers can result in

²⁸This analysis focuses on spillovers of IPs targeted at energy sectors while keeping trade barriers and other policies constant in that sector. Before implementation, industries that receive IP and those that do not, do not differ statistically in their outcomes.

the general equilibrium effects of IP differing considerably from its sectoral effects. This is investigated in the next section.

Cross-Sector Spillovers and Aggregate Effects

To study the cross-sector spillovers and aggregate effects of industrial policies, a quantitative trade model is used (similar to Hodge and others 2024; Ju and others 2024; Lashkaripour and Lugovskyy 2023; and Rotunno and Ruta 2025). The model features labor as the only factor of production and 20 granular sectors with input linkages between sectors and countries. External economies of scale at the sector level that are not internalized by firms when making production and hiring decisions create a rationale for IP. In the scenarios under consideration, all advanced economies conduct industrial policy, and the focus is on domestic outcomes in that block of countries.

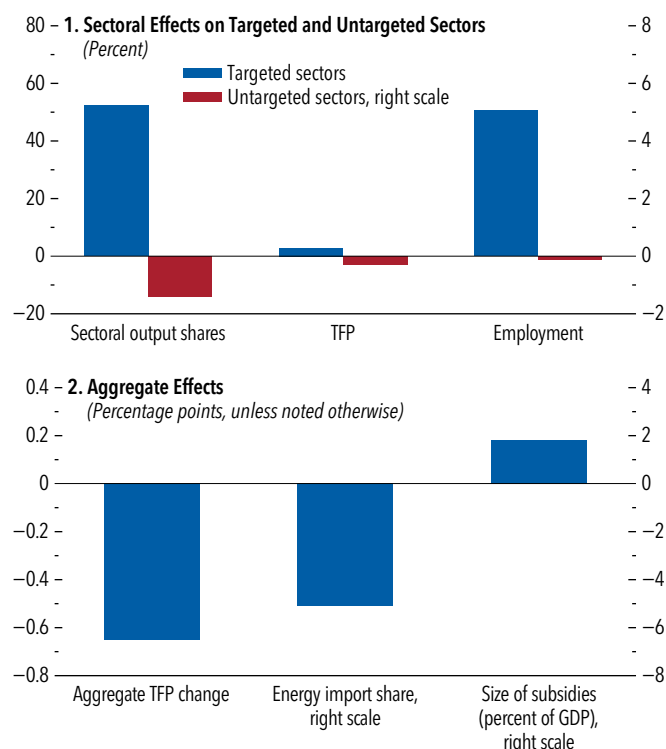
IP in one sector: energy. The first scenario focuses on the cross-sectoral effects of IP in the energy sector.²⁹ Implementing externality-correcting subsidies in the energy sector leads output in the sector to rise by more than 50 percent as employment ramps up.³⁰ Since industries in this sector feature increasing returns to scale, sectoral TFP rises by almost 3 percent (Figure 3.12, panel 1). However, growth in employment draws workers from non-energy sectors. As some of the untargeted sectors have increasing returns to scale, this labor reallocation reduces their TFP.³¹

In aggregate, higher TFP in the energy sector and lower TFP in non-energy sectors result in a small drop in economy-wide TFP. This is because the energy sector (as a whole) does not have the highest returns to scale in the calibration. Moreover, the

²⁹Whereas the focus in Figures 3.7 and 3.8 was on IP in the clean technology sector in the EU, here the scope is much broader and includes energy commodity mining (ISIC sector B05–06), coke and petroleum refining (ISIC sector C19), and electrical equipment (ISIC sector C27). Thus, it captures both the extraction and processing of energy commodities and the capital goods used by the energy sector. See Online Annex 3.7 for details of an exercise that limits the scope of IP to clean technology.

³⁰Sector-specific scale-elasticity parameters are calibrated based on estimates from Bartelme and others (2025). Sectoral subsidy rates are chosen to correct distortions associated with external economies of scale in the energy sector (Ju and others 2024; Lashkaripour and Lugovskyy 2023).

³¹Across non-energy sectors, those with a high input share of energy tend to benefit from energy IP, whereas the output contraction in non-energy sectors is concentrated in those with low energy shares, notably services.

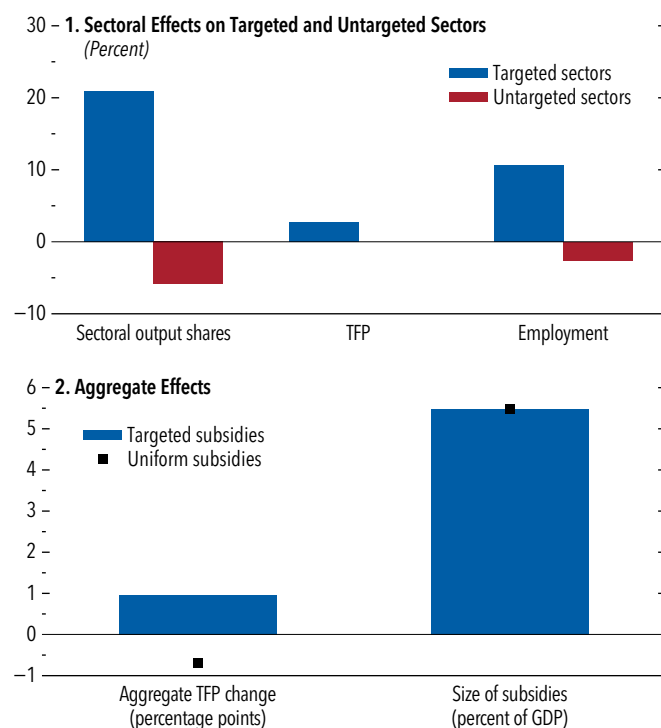
Figure 3.12. Sectoral and Aggregate Effects of Industrial Policy in the Energy Sector

Sources: Global Trade Alert; Market Access Map; Organisation for Economic Co-operation and Development, Inter-Country Input-Output tables and Trade in Value-Added indicators; and IMF staff calculations.

Note: Figure shows changes in outcomes in energy industrial policy (IP) scenario relative to the status quo baseline from estimates of quantitative trade model. Energy IP scenario simulates introduction of optimal subsidies in the energy sector. IPs are introduced for the AEs in the sample (Australia, Canada, EU, Iceland, Israel, Japan, Korea, New Zealand, Norway, Switzerland, United Kingdom, United States), and results are reported as weighted average effect across all AEs, unless noted otherwise. Weights are shares in total output by AEs. Targeted energy sectors are “energy mining,” “coke and petroleum refining,” and “electrical equipment.” IPs in all other sectors (untargeted sectors) remain unchanged. Panel 1 reports percentage change in sectoral output, TFP, and employment calculated as the weighted sum across targeted and untargeted sectors. Panel 2 reports percentage changes in aggregate TFP. Subsidy costs are reported as change relative to the status quo baseline. AEs = advanced economies; TFP = total factor productivity.

fiscal cost of the IP is steep, at an annual expenditure of 1.8 percent of GDP in the new long-run steady state. At the same time, energy imports as a share of energy consumption fall by 5.1 percentage points (Figure 3.12, panel 2). Thus, there is a trade-off between greater energy self-reliance on the one hand and falling aggregate efficiency and larger public expenditure on the other.

Well-targeted IP across sectors. The previous scenario featured a decline in aggregate productivity because resources were withdrawn in many non-energy sectors with increasing returns to scale. The next scenario

Figure 3.13. Sectoral Effects and Aggregate Effects of Optimal and Uniform Industrial Policy

Sources: Global Trade Alert; Market Access Map; Organisation for Economic Co-operation and Development, Inter-Country Input-Output tables and Trade in Value-Added indicators; and IMF staff calculations.

Note: Figure shows changes in heterogeneous industrial policy (IP) scenario relative to the status quo baseline from estimates of quantitative trade model. Heterogeneous IP scenario simulates introduction of optimal subsidies in all sectors with increasing returns to scale, that is, manufacturing sectors. IPs are introduced for the AEs in the sample (Australia, Canada, EU, Iceland, Israel, Japan, Korea, New Zealand, Norway, Switzerland, United Kingdom, United States), and results are reported as weighted average effect across all AEs, unless noted otherwise. Weights are shares in total output by AEs. Panel 1 reports percentage change in sectoral output, TFP, and employment calculated as the weighted sum across targeted and untargeted sectors. Panel 2 reports percentage changes in aggregate TFP. Subsidy costs are reported as change relative to the status quo baseline. AEs = advanced economies; TFP = total factor productivity.

simulates a broader IP strategy, with subsidies rolled out for every sector of the economy with increasing returns to scale. Major advanced economies implement “optimal” IP—with subsidies increasing in a sector’s returns to scale.³² In this scenario, output and employment rise sizably in the targeted sectors (Figure 3.13, panel 1). This leads to aggregate TFP gains due to the expansion in sectors with increasing returns to scale. However, achieving these results requires fiscal resources of close to 5.5 percent of

³²It should be noted that this model does not incorporate strategic competition between countries or retaliatory cycles, which could in principle drive a “race to the bottom” and erode global benefits from returns to scale.

GDP annually, targeted with great precision to correct scale externalities across all sectors, a high bar.³³

Moreover, even with precise targeting, the effects may be smaller in practice because of implementation challenges and the overall business and macroeconomic environment, as seen in this chapter's case studies.

Mistargeted IP. In practice, governments may lack accurate information about returns to scale or be subject to capture by special interests. A final scenario evaluates the effects of IP when subsidies are not optimally targeted. Specifically, subsidies are increased uniformly across all sectors, irrespective of whether they present increasing returns to scale. The aggregate fiscal envelope is held constant relative to the previous scenario with perfect targeting. In this scenario, aggregate productivity declines slightly despite the large fiscal cost of 5.5 percent of GDP (Figure 3.13, panel 2). Whereas productivity improves in some sectors with increasing returns to scale, it declines in other sectors, leading to a slight decrease in aggregate productivity. This illustrates that the precise identification and targeting of sectors with increasing returns to scale is critical for IP to achieve aggregate gains.

Conclusions and Policy Implications

Industrial policy has returned to the center of the policy debate. If well designed and targeted to address production-side market failures, it can improve economic outcomes at sectoral and aggregate levels. The experience of countries such as Korea illustrates that carefully crafted subsidies, aligned with clear objectives and implemented within a sound institutional framework, can catalyze structural transformation.

However, the risks that IP may not deliver economic gains are significant. Effectiveness is highly sensitive to conditions that are difficult to assess *ex ante*—such

as the extent of learning by doing, proximity to the technological frontier, and market size. Even when well targeted, interventions can be fiscally costly. For instance, a clean technology subsidy in the EU sufficient to onshore a significant share of production could cost about 0.4 percent of annual GDP, close to half of the EU budget. Poorly targeted policies risk wasting scarce fiscal resources without delivering meaningful returns. Country-specific circumstances matter, and the successful implementation of industrial policy rests on strong institutional capacity and good governance, constraints that may be particularly relevant in emerging market and developing economies. The role of complementary structural reforms that do not target particular firms or sectors but aim to improve the general business environment is vital.

Moreover, even when delivering sectoral improvements, IP entails important trade-offs. Cross-sectoral spillovers can be negative, undermining aggregate productivity even as targeted sectors expand. And even though they are not the focus of this chapter, adverse cross-country spillovers and retaliatory cycles are likely to further reduce net benefits from domestic IP. Policies that enhance resilience—such as onshoring—may come at the cost of efficiency, including higher consumer prices during the transition. And spillovers can have mixed effects across dimensions: for example, energy sector IP may enhance energy security and raise value added in downstream industries while drawing resources away from more productive sectors, reducing allocative efficiency.

These findings underscore the importance of careful policy design and implementation. Governments should be mindful of the risks of wasteful spending, especially when debt is elevated and fiscal space limited. They should weigh the opportunity cost of IP against potentially more efficient horizontal policies. And they should recognize and manage trade-offs explicitly. If IP is pursued, it should be grounded in clear diagnostics of market failures, include mechanisms for regular evaluation and recalibration, and be embedded within a strong institutional and macroeconomic framework. Market discipline should be encouraged through vigorous domestic and international competition. Doing so will increase the likelihood that IP delivers on its promise—without compromising fiscal sustainability or economic efficiency.

³³Despite the large fiscal costs, fiscal multipliers are higher than 1 in the simulations. It is also important to note that in this scenario, *all* sectors with increasing returns to scale receive subsidies that fully correct the externality, which would require a subsidy proportional to the returns-to-scale parameters for each sector. Thus, in such models, the size of the needed subsidies depends on calibration of the returns-to-scale parameter (as discussed in Lashkaripour and Lugovskyy 2023; Bartelme and others 2025; and Ju and others 2024). In addition, the quantitative trade model has a simplified fiscal sector with tariff revenue lump-sum rebates to households and subsidies financed via lump-sum taxation. This abstracts from distortionary taxation, other types of government spending, and dynamic fiscal effects.

Box 3.1. Industrial Policy in China: Quantification and Impact on Misallocation

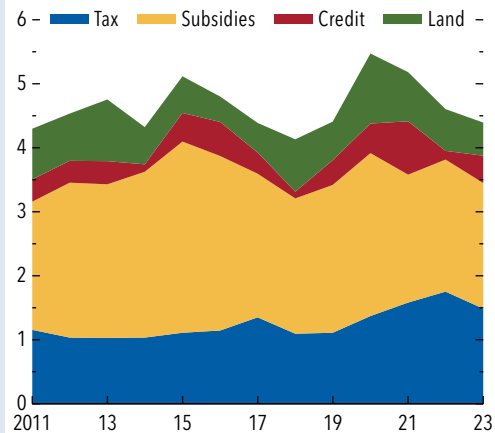
China has long used various industrial policy tools to support priority economic sectors, including (but not limited to) cash subsidies, tax benefits, subsidized credit, subsidized land, and trade and regulatory barriers that benefit incumbent firms (State Council 2005). This has had a material impact on the economy, helping to develop specific industries and technologies. However, it has also generated fiscal costs and potential factor misallocation.

Based on financial reports of listed firms and the registry of land transactions, Garcia-Macia, Kothari, and Tao (2025) estimate the equivalent fiscal cost of industrial policy in China to be about 4 percent of GDP between 2011 and 2023 (Figure 3.1.1). Cash subsidies were the costliest instrument, followed by tax benefits (which have grown since the pandemic), land subsidies, and subsidized credit. Most of this support was directed to the manufacturing sector, with industries like semiconductors, high-tech manufacturing, and automobiles benefiting especially from cash subsidies and tax benefits.

While the strategic direction of industrial policy in China is set by the central government in five-year plans (for example, State Council 2021), implementation is highly decentralized through local governments (Fang, Li, and Lu 2025). This can lead to wasteful duplication and excess investment followed by capacity cuts, as seen in sectors like coal and steel in the 2010s (IMF 2018, 2019), but it can also favor policy experimentation. A case in point is the electric vehicle (EV) sector. China made a strategic decision to prioritize EVs in 2009, when the market was virtually nonexistent. The government initially provided producer subsidies, leveraged public procurement, and required carmakers to focus on EVs, but later shifted support to consumer subsidies as it realized too many firms were entering the market (Branstetter and Li 2023; Chapter 2 of the April 2024 *Fiscal Monitor*).

The authors of this box are Daniel Garcia-Macia and Siddharth Kothari.

Figure 3.1.1. China: Industrial Policy Support
(Percent of GDP)



Sources: Baidu Maps; Garcia-Macia, Kothari, and Tao 2025; Ministry of Natural Resources of the People's Republic of China; Wind Information Co., Ltd.; and IMF staff calculations.

Note: Industrial policy is defined as sector-specific subsidies. Results for listed firms are extrapolated to unlisted firms. See further details in Garcia-Macia, Kothari, and Tao (2025).

Despite the success in some technologies, industrial policy appears to have lowered overall productivity by distorting the allocation of production factors across firms and sectors. Combining a sector-level measure of industrial policy counts (Juhász and others 2022) with revenue productivity outcomes for a large sample of firms, Garcia-Macia, Kothari, and Tao (2025) show that subsidies led to inefficiently high production in targeted sectors, while trade and regulatory barriers limited production to suboptimal levels, possibly by increasing the market power of incumbent firms. Evaluating these results with a structural model, factor misallocation induced by industrial policies is found to have reduced China's aggregate total factor productivity by 1.2 percent and its GDP by as much as 2 percent.

Box 3.2. Support or Distort: Evaluating National State Aid in Europe

Since the global financial crisis, EU governments have increasingly supported firms through state aid, which peaked at almost 1.5 percent of GDP in 2022. State aid is provided by national governments and, therefore, risks skewing competition in favor of domestic companies and eroding the level playing field in the EU single market. This box examines how state aid affects employment and revenue at beneficiary firms as well as nonrecipients in competing industries across borders in Europe (Brandão-Marques and Toprak 2024).

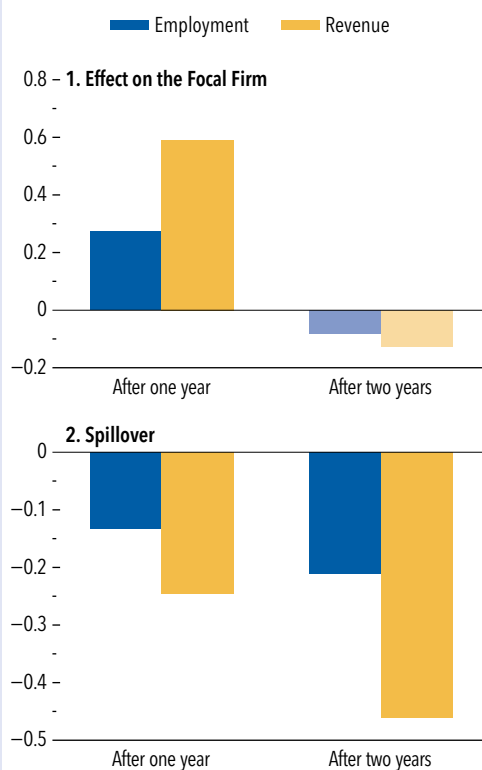
Drawing on firm-level data from six major EU economies, regressions show that state aid provides a lift to recipient firms, increasing revenues and employment, but only temporarily, as shown in Figure 3.2.1. To ensure that the relationship is causal, state aid shocks are defined as the unanticipated excess equity return (in percent) observed the day government aid to a firm is announced. A 1 percent state aid shock is followed, after one year, by a 0.3 percent increase in the recipient firm's employment and a 0.6 percent increase in its revenue. These gains, however, largely dissipate by the second year, which is consistent with state aid providing only temporary relief of financial constraints. The effects are strongest for smaller, younger firms that are highly leveraged and have low cash buffers.

Firms based in other EU countries that operate in the same industry but do not receive state aid suffer significant employment and revenue losses from cross-border spillovers. After a 1 percent unanticipated aid shock to a peer, employment in nonrecipient competing firms falls by about 0.13 percent and revenues by roughly 0.24 percent the following year. These adverse impacts deepen over time, with employment declining by 0.21 percent and revenue dropping by 0.46 percent in the second year. Moreover, the effects are more pronounced in more concentrated sectors. This suggests that state aid distorts competition as recipients tend to crowd out nonrecipient firms that operate in the same industry.

These findings highlight a clear trade-off: While national state aid by EU members can help recipients in the short run, state aid also causes negative spillovers to firms operating in the same industry that

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Figure 3.2.1. Effects of State Aid on Recipient and Nonrecipient Firms



Sources: Brandão-Marques and Toprak 2024; and IMF staff calculations.

Note: The bars show the impact of 1 percent excess return (state-aid shock) on recipient firms and on competing nonrecipient firms. Solid bars indicate effects that are statistically significant at the 10 percent level or higher, while shaded bars denote effects that are not statistically significant.

do not receive the aid. This could risk fragmenting Europe's single market by disadvantaging firms across borders and creating distortions that could jeopardize the efficient allocation of resources and the benefits from EU-wide competition. Hence, should there be a case for state aid to firms in the EU to address specific market failures, this should be done at the EU level instead of by individual member states to mitigate adverse spillovers and preserve equitable conditions for firms across the single market. Moreover, by reducing spillovers, the pooling of resources at the EU level could also ensure a more efficient use of funds and limit waste.

Box 3.3. A Comparison between Industrial and Structural Policies

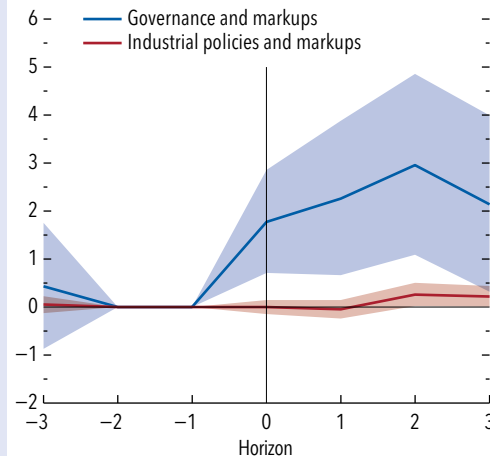
Structural reforms can yield better outcomes than industrial policies (IPs). Like IPs, structural reforms aim at tackling key frictions hampering growth and productivity. Unlike IPs, these policies target economy-wide frictions; their effectiveness generally does not rely on information about sector-level characteristics, including distortions; and they have been associated with improved macroeconomic outcomes (Chapter 3 of the October 2019 *World Economic Outlook*; Budina and others 2023). But structural reforms can also yield better sector-level outcomes than IPs. For instance—and although estimation is imprecise—a significant improvement in governance can boost industry value added in high-distortion sectors (characterized by high markups) relative to low-markup sectors by 2.1 percent, whereas IPs targeting sectors with those distortions may be associated with only a 0.2 percent increase (Figure 3.3.1). Similarly, improvements in financial development and private sector access to credit are more effective than IPs at bolstering economic activity in sectors highly dependent on external financing (Baquie and others 2025).

In addition, while the fiscal costs of IPs can be high—as they can entail sizable subsidies—structural reforms often result in lower fiscal costs, and some can even lead to increased fiscal revenues—for example, if they improve tax collection. Fiscal costs are an important consideration at a time of limited fiscal space (Aligishiev and others 2023; Chapter 2 of the April 2024 *Fiscal Monitor*). Therefore, structural reforms seem to provide better results with lower fiscal costs and reduced distortion risks. Given these trade-offs, countries should weigh the fiscal sustainability of IPs carefully and prioritize structural reforms that offer more cost-effective paths to inclusive and sustained growth.

Even when IPs are desirable, structural reforms are essential for their success. Structural fundamentals such as governance quality or a good business environment could strengthen the link between IPs and economic performance by reducing risks of rent-seeking behavior and improving targeting (IDB 2014; Cherif and Hasanov 2019; Cherif and Hasanov 2020; Criscuolo, Lalanne, and Díaz 2022; Criscuolo and others 2022; García-Macia and Sollaci 2025). Other structural conditions, such as a more educated work-

Figure 3.3.1. Industrial Policies versus Governance Reforms

(Industry value added, percent)



Sources: Baquie and others 2025; Budina and others 2023; Global Trade Alert; Juhász and others 2022, 2025; Orbis; and IMF staff calculations.

Note: The dependent variable is the log difference of the sectoral-level value added over the horizon considered. 0 = the short-term horizon corresponding to when industrial policies are introduced. The variables of interest are the interaction between the change in protectionist industrial policies and sectoral markups and the interaction between sectoral markups and the quality of governance index from Budina and others (2023). Differently from Baquie and others (2025), the figure reports changes from the 25th percentile to the median of the distributions of markups, governance, and industrial policies. Shaded areas represent 90 percent confidence intervals. For more details, see Baquie and others (2025).

force, can enhance learning by doing and innovation sparked by well-crafted IPs. Indeed, firms in countries with a better business environment experience higher capital accumulation in the short term in response to IPs (Baquie and others 2025). Moreover, firms in emerging market and developing economies with better governance and higher human capital experience higher value-added growth after the implementation of IPs. Complementarity between IPs and structural factors in emerging market and developing economies suggests that policies to improve fundamentals may be an important precondition for IPs' success (Deléchat and others 2024). Overall, these findings suggest a phased approach: first strengthen structural factors, then address sectoral issues with targeted interventions.

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