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The return of industrial policies: Policy considerations in the current context

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Abstract/Résumé

The return of industrial policies: Policy considerations in the current context

The paper contributes to renewed debates about industrial policy in the context of recent initiatives in several OECD economies. It discusses the *pros* and *cons* of industrial policies motivated by environmental, national security and place-based/inclusiveness objectives. The paper also considers implementation and design issues, and how to respond to industrial policies in other countries. There are well-grounded economic, social and environmental justifications for some industrial policies. However, there are legitimate concerns that the benefits of such policies could be limited and the costs high. This mainly relates to measures curbing domestic and international competition and the practical and political challenges in designing and implementing effective measures. Thus, while governments may want to experiment with future and welfare-oriented industrial policies, they should exert moderation in scope, exercise caution in design and implementation, and be mindful of possible negative international implications.

Keywords: industrial policy; government subsidies; trade policy; green transition, innovation, national security

JEL Classification: F52, H2, H81, L5, F13, O25, O3, Q5

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Le retour des politiques industrielles : considérations politiques dans le contexte actuel

Le document contribue aux débats renouvelés sur la politique industrielle dans le contexte d'initiatives récentes dans plusieurs économies de l'OCDE. Il discute les avantages et les inconvénients des politiques industrielles motivées par des objectifs environnementaux, de sécurité nationale et d'inclusion territoriale. Le document examine également les problèmes de mise en œuvre et de conception, ainsi que la question des réponses à apporter aux politiques industrielles des autres pays. Il existe des justifications économiques, sociales et environnementales bien fondées pour certaines politiques industrielles. Cependant, il existe des inquiétudes légitimes quant au fait que les avantages de telles politiques pourraient être limités et leurs coûts élevés. Cela concerne principalement les mesures limitant la concurrence au niveau national et international et les défis pratiques et politiques liés à la conception et à la mise en œuvre de mesures efficaces. Ainsi, même si les gouvernements souhaitent expérimenter des politiques industrielles futures axées sur le bien-être, ils doivent faire preuve de modération dans leur étendue, faire preuve de prudence dans leur conception et leur mise en œuvre et être attentifs aux éventuelles implications négatives sur le plan international.

Mots-clés : politique industrielle ; subventions gouvernementales ; politique commerciale ; transition verte ; innovation ; sécurité nationale

Classification JEL: F52, H2, H81, L5, F13, O25, O3, Q5

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Main issues and policy recommendations

Rationales for industrial policy strategies

- Industrial policies can play a role in addressing important economic, social and environmental challenges that markets cannot deal with on their own. When they are successful, industrial policies can bring large benefits for the nation concerned. They could also have positive international spillovers, for instance if they lower the cost of the green transition.
- Industrial policies entail costs, including fiscal ones. They can create market distortions that have negative effects on innovation and the availability and prices of goods and services. Costs can be particularly high when measures effectively limit competition and increase protectionism. Ultimately, they may reduce market contestability and undermine the rules-based trading system.
- Government incentives are not always effective in stimulating desired changes in the economy. Other policies may be more efficient and effective in delivering economic, social, environmental and security objectives.
- Uncertainty about the benefits and costs of industrial policies and limited public resources suggest that governments should prioritise areas where existing structural challenges cannot be addressed solely by markets and other government policies and where these challenges imply high and growing societal costs. Governments should consider whether industrial policies are effective and efficient to pursue those objectives, and what other government policies will be needed for the full range of expected benefits to be achieved.

Green industrial policies

- The potentially huge social and economic costs of climate change call for a rapid and large-scale adoption of clean technologies. While green industrial policies that target a reduction in greenhouse gas (GHG) emissions may not be the most efficient instruments, they could be more politically acceptable than price-based measures. They can also reinforce other climate-related policies.
- The justification for industrial policies to back green technology innovation relies on their potential to expand ways to reduce GHG emissions and to lower the costs of available technologies. Promoting the consumption and production of green technologies has both advantages and disadvantages, and no approach is clearly preferable to the other. Support to consumption avoids potential trade conflicts that could arise with subsidies to production. Protectionist measures to achieve environmental objectives can be particularly counter-productive by making the green transition longer and more expensive and by alienating key trade partners.

National security-motivated industrial policies

- Ensuring national security is an important government objective and it has increasingly influenced economic policy in a growing number of areas. Achieving it by limiting or modifying foreign trade exposures with the help of industrial policies risks being costly and ineffective. Thus, using industrial policy to achieve national security goals should be restricted to selected critical products based on a well-grounded analysis and where they are expected to be effective.

Place-based industrial policies

- Place-based strategies could foster equitable economic development in countries with large regional disparities. Thus, they could contribute to addressing inclusiveness and fairness. However, empirical evidence on their effectiveness is mixed. They can also be costly compared to alternative policies.

Design and implementation considerations

- Despite economic, social and environmental desirability of some industrial policies, designing and implementing them to maximise benefits and minimise costs is difficult in practice. There are ways to minimise risks of such outcomes, but they are not always effective.
- Measures should be tailored to specific well-identified obstacles to achieving stated objectives. Collaboration and co-ordination between the private sector and the government could facilitate identifying what the binding obstacles are and selecting appropriate measures.
- A comprehensive industrial strategy targeted at a specific objective is likely to be more effective in solving market failures than individual industrial policy measures as obstacles to reaching the objective could be of different nature.
- Improving general business conditions may not be enough to induce desired changes. This suggests a role for targeted measures supporting specific industries, technologies or geographic areas. Targeted measures could involve some complementarities with improving general business conditions though, such as better regulatory frameworks that reduce barriers to entry and expansion.
- When targeted measures are needed, several factors argue for them being limited in time and size. However, they should be sufficiently persistent and predictable to be able to change the behaviour of firms and individuals. Longer horizons of public support could be useful when large-scale investment and innovation are needed, implementation periods are long, future demand conditions are highly uncertain, and when resource constraints could hinder investment and add to inflationary pressures.
- The selection process of businesses to be helped by industrial policies should be competitive, non-discriminatory and transparent to avoid favouring incumbents and deterring new entrants. To ensure such outcomes, policy makers should consider delegating such selection processes to expert institutions, ideally with a well-established reputation, that are capable of undertaking technical evaluations of projects and are free from political pressure, while safeguarding democratic oversight and accountability.
- Political factors make decisions to terminate government support when objectives are not being achieved or unintended consequences alter the cost-benefit assessment of programmes difficult. Thus, institutional safeguards, such as clear benchmarks, close monitoring and explicit mechanisms for ending the support, are needed.
- Countries can face dilemma about how to respond to industrial policies implemented by other nations. Adopting a tit-for-tat strategy may not necessarily be the most prudent course of action.
- In countries with high government debt and large budget deficits, the capacity to devise industrial policies could be significantly limited. Thus, the motivation for adopting industrial policies should be particularly well justified and specific measures carefully selected.

The return of industrial policies: Policy considerations in the current context

1. Introduction

1. The series of global economic crises over the past two decades have resulted in increasing government interventions to boost economic and social stability. Dissatisfaction with globalisation, partly due to disappearing manufacturing jobs in advanced economies, have rekindled interest in industrial policies and trade protectionism. In addition, supply chain disruptions during the COVID-19 crisis, geopolitical tensions and rivalries as well as Russia's war of aggression against Ukraine have led to intensified calls on governments. These calls urge the authorities to wield trade, foreign investment and industrial policies to improve economic security by limiting dependency on foreign economies, diversifying supply chains for critical components and services, and developing domestic production capacities. Industrial policies have also been motivated by the needed acceleration with the decarbonisation of economies.

2. There is no commonly agreed definition of industrial policy (Criscuolo et al., 2023[1]; Terzi, Singh and Sherwood, 2022[2]; OECD, 2023[3]; Juhász, Lane and Rodrik, 2023[4]). Industrial policies usually refer to government help to businesses to boost or reshape specific economic activity, especially targeted at selected firms or types of firms based on their activity, technology, location, size or age. Sometimes, measures to improve the overall industrial and innovation ecosystem available to all firms (horizontal policies) are also included. Industrial policies can involve a mixture of financial measures, like grants, tax incentives and below-market financing, and non-financial ones, such as regulation and regulatory sandboxes.[1] Industrial policies can also be accompanied by trade protectionist measures, including import tariffs, local content requirements and export restrictions.

3. The paper focuses primarily on targeted measures, which are both increasingly used in recent years and raise more concerns about their implications for domestic and international markets and trade rules. It discusses in more detail three broad industrial policy strategies motivated by environmental, national security and place-based/inclusiveness objectives, recognising that recent initiatives usually combine all of them and that there are other possible justifications.

4. Against this background, the paper provides a brief account of the return of industrial policies in some OECD countries (the major recent industrial policy initiatives by selected economies are summarised in Annex A). The main part of the paper is devoted to policy considerations in the context of recent measures. It presents the *pros* and *cons* of industrial policies rather than providing definite and detailed recommendations for specific measures in particular industries and countries. In doing so, it builds on an extensive and rapidly growing literature, including from the OECD. Given the recent upsurge in industrial

[1] Regulatory sandboxes relax selected regulatory obligations of companies to facilitate small-scale live testing of innovative products for a limited period. They have been increasingly used in OECD countries to foster innovative entry in sectors such as energy, transport and fintech (Attrey, Lesher and Lomax, 2020[178]).

policy innovations, the assessment of their impact is still far from settled. As such, the paper provides general suggestions about the desirability of using industrial policy, in view of theoretical arguments as well as efficiency and cost-benefit considerations. The paper discusses political risks with policy implementation and what to do about them. It considers options for responding to industrial policies implemented in other countries. A final section concludes. Separate annexes describe issues related to the conceptual framework of classifying industrial policies, evaluation challenges and empirical evidence.

2. Industrial policies are back in vogue

5. Industrial policies were particularly popular in the aftermath of World War II. At the time, broad consensus prevailed that the provision of public goods and services, government support to technological progress as well as multilateral arrangements in trade and finance were the best way to achieve post-war reconstruction and to raise living standards (Salazar-Xirinachs, Nübler and Kozul-Wright, 2014[5]). This policy consensus, lasting around three decades, was also endorsed in developing economies. Several countries adopted industrial, technology and trade policies as part of economic development strategies, especially in East Asia and Latin America.

6. Since the mid-1960s, industrial policies started to lose appeal as mainstream economics stressed the distortions arising from state intervention and documented failures, and even damages, of some industrial policies.[2] Still, many countries continued to use industrial policy instruments in practice but, often, in a lower-key fashion (Wade, 2012[6]).

7. Industrial policies have again risen in prominence with the series of economic crises and increased awareness of environmental challenges. In recent years, in several advanced economies, there has been a revival in industrial polices to support green and digital transitions as well as employment (Annex A). For example, to meet these objectives, the US government implemented the CHIPS and Science Act and the Inflation Reduction Act (IRA). These initiatives have been partly motivated by the perceived need to respond to the growing economic power of China, which has been using large-scale state interventions for decades (Annex A). In response to strategic and environmental challenges and, in some cases, also in reaction to US and Chinese industrial policies, several OECD economies have proposed or implemented similar measures.

8. A combination of forces have contributed to a growing interest in state intervention, and industrial policies in particular (Wade, 2012[6]; O'Sullivan et al., 2013[7]; Stiglitz, Lin and Monga, 2013[8]; Warwick, 2013[9]; Aiginger and Rodrik, 2020[10]; Johnstone et al., 2021[11]).

- Since the 2000s, concerns have grown about the side effects of globalisation (and technological change), such as disruptions to some industries and local communities, a declining importance of manufacturing employment (Figure 1) as well as unfair competition (Rodrik, 1998[12]; Antràs, 2020[13]; Rodrik, 2021[14]).[3] The negative consequences have contributed to an erosion of the social acceptance of globalisation in advanced economies, prompting politicians to take measures to address these tendencies.
- During the global financial and COVID-19 crises, many governments implemented massive support programmes to stabilise the economy and minimise social costs. Sometimes, these policies included measures to address structural challenges such as climate change (Aulie et al., 2023[15]).

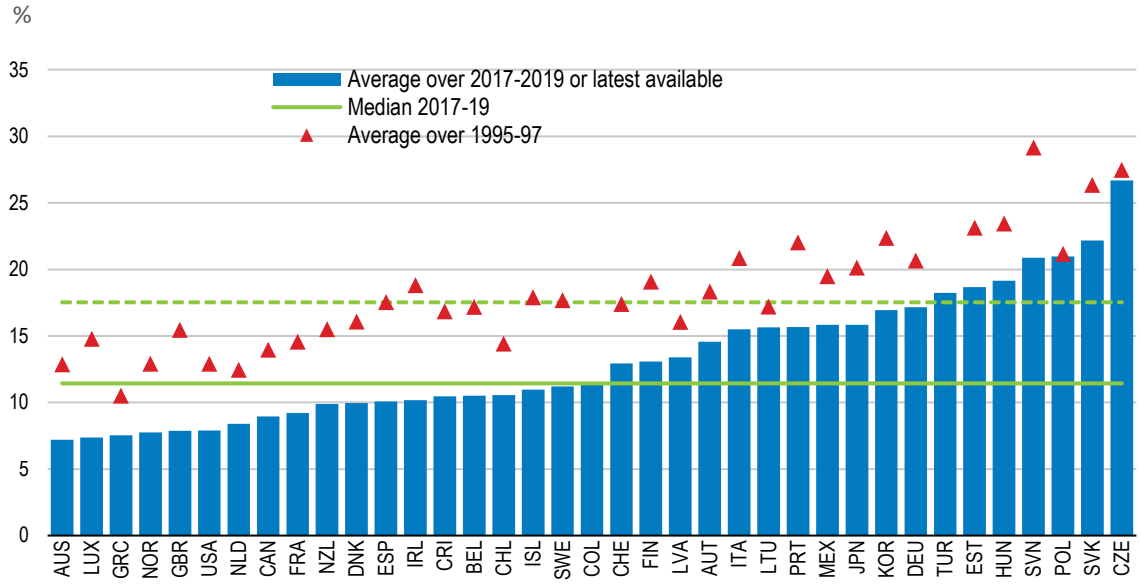
[2] For instance, import substitution policies – widely applied in Latin America – were believed to have led to many economic problems in developing countries (Fishlow, 1989[140]; Baldwin, 2000[141]; Aiginger, 2007[142]; Hasanov and Cherif, 2019[143]; Irwin, 2020[144]).

[3] The decline in manufacturing jobs has also stemmed from technological progress, with the contribution of each trend being debated (Fort, Pierce and Schott, 2018[182]).

This has given rise to expectations amongst households and businesses that government will provide large financial help to deal with important economic, social and environmental challenges. Moreover, support measures by first-mover countries indirectly added pressures on governments in other economies to act too.

Figure 1. Manufacturing employment has shrunk relative to other sectors in OECD countries

Average share of manufacturing employment in total employment



Note: Employment is measured as the total number of persons engaged. Sufficiently long time series are not available for all OECD countries.
Source: OECD STructural ANalysis (STAN) database; and authors' calculations.

- More recently, US-China rivalries and Russia's war against Ukraine have acutely renewed awareness of geopolitical risks stemming from high import dependency (including for critical goods like pharmaceuticals, products underpinning green and digital transitions, and energy). Consequently, national security has become more intertwined with international economics and foreign policy (Lind, 2019[16]), and has been used as an argument for industrial and protectionist policies to buttress state control, self-sufficiency and resilience.
- Over the past decade, there has been also growing realisation that measures to prevent climate change are urgently needed and that there are economic opportunities in the green transition. Government support to development, production and use of "green" goods and technologies is key for addressing these needs (Cervantes et al., 2023[17]).

9. The nature and focus of industrial policies have evolved over recent decades (O'Sullivan et al., 2013[7]; Warwick, 2013[9]; Aiginger and Rodrik, 2020[10]). Since the 2000s, there has been a growing emphasis on improving co-ordination between governments and businesses. In addition, support to activities and businesses has become more focused on strategic sectors from national security and environmental perspectives, and on technology and its dissemination. This contrasts with previously prevailing top-down state intervention to promote national champions in specific manufacturing sectors ("pick winners") and a frequent use of protectionist measures aimed at import substitution.

10. Assessing the scope and scale of government interventions, and their evolution over time, is difficult (Warwick and Nolan, 2014[18]; Terzi, Singh and Sherwood, 2022[2]; OECD, 2023[3]). This is due to a persistent lack of reliable and cross-country comparable data (OECD, 2023[3]; Juhász, Lane and Rodrik,

2023[4]) and the absence of consensus about the definition of industrial policies (Annex B). Data deficiencies reflect both objective difficulties with quantifying government help (especially non-financial aid, below-market financing and opaque operations via state-owned enterprises) and unwillingness of some governments to comprehensively report measures and their costings. Nevertheless, available evidence suggests that industrial policies are an important part of economic policies in advanced and emerging-market economies.

- Preliminary estimates for nine OECD members for the period 2019–21 from the new OECD Quantifying Industrial Strategies (QuIS) project indicate that industrial policy grants and tax expenditures were on average around 1.4% of GDP in 2021 (Criscuolo et al., 2023[1]).[4] However, they varied significantly across countries, ranging from around 2¼ per cent of GDP in France and the United Kingdom to around ¾ per cent of GDP in Ireland and Canada. Industrial policy expenditures are still dominated by a sectoral approach (on average 29% of support through grants and tax expenditures is based on sectoral eligibility criteria). That said, large cross-country differences exist. Green industrial policies account on average for 13% of industrial policy expenditures.[5] Government support is especially prevalent in sectors such as manufacturing, energy and transportation (Figure 2, Panel A).[6]
- Other estimations by DiPippo et al. (2022[19]), using a different definition of industrial policy, suggest that spending on industrial policies in 2019 ranged from 0.3-0.7% of GDP in Brazil, France, Germany, Japan, South Korea, Chinese Taipei and the United States to 1.5% of GDP in China.[7] In the United States, the latest industrial policy initiatives could increase direct fiscal costs by around one third, but their costing is highly uncertain (Annex A). China is one of the countries using industrial policies on a large scale. However, available data and estimates are not sufficient to analyse Chinese policies over time in a comprehensive, robust and timely fashion (Chimits, 2023[20]). Alternative estimates for China range from 1.7% of GDP to 5% of GDP, with the upper estimates including a broader definition of industrial policies, such as government procurement of goods (SCCEI and CCA, 2023[21]).
- OECD estimations based on firm-level data from OECD and non-OECD countries confirm that the amount of support from all levels of government at the global level has been substantial over the past decade in 13 industrial sectors (OECD, 2023[3]).[8] However, government support (including grants, below-market borrowing and tax expenditure) differed across sectors. The average support at the global level in 2005-19 ranged from around 2¼-3% of total sales in solar panels and aluminium to around ½ per cent of total sales in automobile, aerospace and defence, and chemicals sectors. In many sectors, including in aluminium, steel, glass and ceramics and wind turbines, government support was mainly in the form of below-market borrowing, though tax expenditures were also very important, especially in telecommunication network equipment,

[4] They include Canada, Denmark, France, Ireland, Israel, Italy, the Netherlands, Sweden and the United Kingdom. The project also covers EU-level industrial policy expenditures for the participating countries, if relevant. For more information, see http://oe.cd/quis.

[5] Green industrial policy usually refers to government measures that generate environmental benefits, especially via stimulating the development of low-carbon alternatives to fossil fuels (Fay, Hallegatte and Vogt-Schilb, 2013[160]; Rodrik, 2014[29]).

[6] Agriculture and fishery sectors are excluded from this project, but these two sectors receive substantial government support in many OECD economies (OECD, 2022[103]; OECD, 2022[102]).

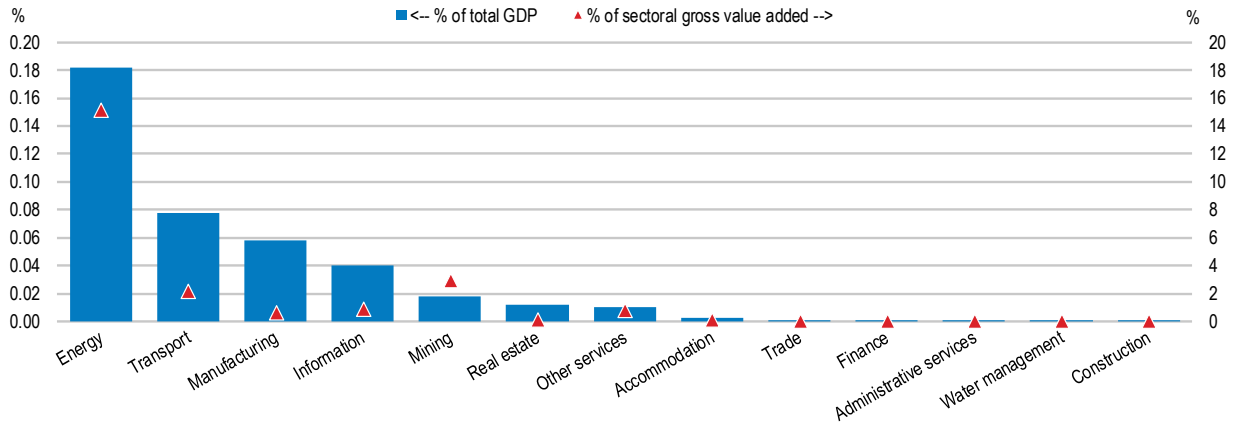
[7] These estimates try to account for multiple tools, among them government grants, tax breaks, below-market-rate credit and state investment funds.

[8] The data covers the largest manufacturing firms in 13 industrial sectors headquartered both in OECD and non-OECD countries, including China.

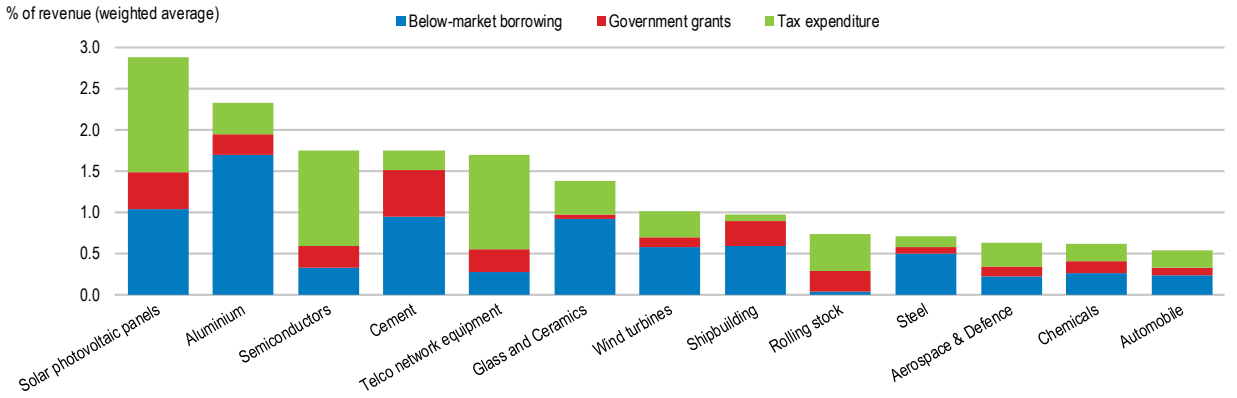
semiconductors and rolling stock (Figure 2, Panel B).[9] Many of the analysed industries are highly concentrated, with several dozens of firms dominating global sales, implying that governments supported mainly large companies. Across all sectors, firms with at least 25% government ownership received more of all forms of government support. State enterprises were also important providers of energy, inputs and finance to other firms on below-market terms.

Figure 2. The extent of government support varies substantially across sectors

A. Sectoral grants and tax expenditures in 2021, average across nine OECD countries



B. Government support across selected industrial sectors at the global level (including China), 2005-2019 average



Note: In Panel A, the nine countries are: Canada, Denmark, France, Ireland, Israel, Italy, the Netherlands, Sweden and the United Kingdom. Policy instruments targeting agriculture are excluded from the scope of the report. In Panel B, data are expressed relative to the sales revenue of the firms covered in the study over the period 2005-19 and weighted by firm revenues. Firms both from OECD and non-OECD countries (including China) are included. Tax expenditures are less directly comparable across jurisdictions and sectors than grants and below-market borrowing. This is because any given tax expenditure can result in a different amount of tax revenue foregone as tax parameters vary across countries.

Source: Criscuolo et al. (2023[1]) "Quantifying industrial strategies across nine OECD countries", *OECD Science, Technology and Industry Policy Papers*, No. 150, OECD Publishing, Paris, https://doi.org/10.1787/5f2dcc8e-en; and OECD (2023[3]), "Government support in industrial sectors: A synthesis report", *OECD Trade Policy Papers*, No. 270, OECD Publishing, Paris, https://doi.org/10.1787/1d28d299-en.

[9] Below-market borrowing refers to the provision of debt financing by government-related financial institutions at contractual terms that are more favourable than those offered by private institutions.

- The *number* of industrial policies has increased considerably over the past decade and is particularly high in advanced economies (Juhász et al., 2022[22]).[10] Industrial policies are prevalent in machinery and transport equipment and some heavy industry sectors. They mainly rely on trade finance, state loans, financial grants and local content requirements. Moreover, 60% of the number of industrial policies is targeted at specific firms. However, these count statistics do not indicate economic importance of implemented measures and their comparability has been questioned (Chimits, 2023[20]).

3. Policy considerations

3.1. Motivations for industrial policies

11. The theoretical justification for industrial policies rests on the existence of unpriced positive and negative externalities, implying some gaps between private returns and social benefits.[11] Such gaps may arise due to the existence of learning-by-doing and economy-of-scale effects,[12] co-ordination failures, and when firms and consumers do not fully bear social costs of their production or consumption, or underinvest in public goods (or in research and innovation) as they are unable to reap the private returns. In all those cases industrial policy intervention could help narrow the gap between private returns and social benefits. A clear case of a market failure is the negative implications of unpriced greenhouse gas emissions (GHG) on the climate and, in turn, societies and economies. Similarly, politicians often argue that excessive foreign exposures via trade and foreign investment can threaten national security in case of geopolitical conflicts, despite positive effects in peacetime. Finally, large disparities in income and employment between geographic areas or specific population groups can result in high social costs and polarisation, which are not adequately priced by individual firms.

12. Horizontal industrial policies usually intend to support broader goals, such as growth, competitiveness and innovation, whereas targeted measures tend to aim at more specific sectors, industries or technologies. For instance, recent mission-oriented and technology-focused strategies have been mainly motivated by environmental, national security and other societal challenges that require public-private collaboration to identify and develop innovative solutions (Criscuolo et al., 2022[23]).

3.2. Industrial policy should be justified by efficiency and cost-benefit considerations

13. Not all market failures should be addressed by industrial policies. The latter may help reduce misallocation of resources across sectors, for example by stimulating investment in innovation and green technologies, or to help disadvantaged geographic areas. However, some market failures can be addressed by other policies, and – in some cases – alternative policies can be more efficient. For example, the toolkit that governments are considering for the green transition includes incentives for research and development (R&D), carbon taxation, production and consumption subsidies, as well as regulatory measures. But these measures have different effects and trade-offs. Meanwhile, distributional objectives could be achieved not only by subsidies to investment or production in disadvantaged areas but also by

[10] Juhasz et al. (2022[22]) identify industrial policies as all policies that include in their description, from the global database of commercial policies, goal-oriented actions aimed at changing the composition of economic activity.

[11] See Table A B.1 in Annex B for a list of rationales, including theoretical ones, justifying industrial policy interventions.

[12] Government protection and support to emerging industries in their early stages of development to advance economic growth have been used as a common rationale for industrial policy (the so-called infant industry argument). Several disadvantages faced by nascent industries or firms, compared with mature ones, may justify government intervention. Such disadvantages can diminish over time given learning by doing and economy of scale effects, where productivity increases and costs fall with experience and with the rise in production.

education and training programmes, well-designed labour market regulation, tax and social protection systems, and support to local infrastructure.

14. The ultimate decision about implementing industrial policy in a specific area should be based on cost-benefit analysis, also taking into account difficult to quantify elements. However, comprehensive and accurate *ex-ante* evaluations and *ex-post* assessments of industrial policies are challenging (Annex C). This reflects insufficient data, multiplicity of measures and objectives,[13] and econometric complexities to infer causal effects from past episodes of measures being adopted. Indeed, empirical evidence about effectiveness of specific industrial policies in reaching the stated objectives is mixed (Criscuolo et al. (2022[24]); Annex D). Moreover, even in the presence of robust evidence, it may not necessarily guarantee similar outcomes in different periods or countries. Industrial policies are inherently context-dependent, making it challenging to draw policy generalisations from past experiences (Warwick and Nolan, 2014[18]).[14]

15. When industrial policies are successful in reaching their objectives, they can bring large benefits for the country concerned, including preventing welfare costs of inaction, but also more globally. As mentioned above, government intervention can help better align market outcomes with broader economic, social and environmental goals. There are many examples of positive outcomes of industrial policies. For instance, horizontal policies have been shown to be effective in raising public and private R&D spending, innovation and productivity, all of which are crucial for reaching sustained improvements in living standards (OECD, 2023[25]; OECD, 2015[26]). Governments may also seek to change the direction of production and technology development to reach specific social or environmental objectives. Government grants to both public and business R&D and innovation to boost investment in vaccine research in response to the COVID-19 pandemic helped develop effective vaccines (OECD, 2023[27]). Industrial policies have also contributed to the reduction in the cost of production of green technologies, like solar panels and wind turbines, and subsequently in GHG emissions (IRENA-GWEC, 2013[28]; Rodrik, 2014[29]; IEA, 2022[30]). Likewise, incentivising investment in regions severely affected by unemployment were effective in raising firm employment in some disadvantaged areas (Criscuolo et al., 2019[31]).

16. One of the concerns about industrial policy is that some direct financial incentives, like government grants or tax exemptions, may not be powerful enough to implement desired and sizeable changes in the economy. This could be due to an insufficient scale of public support, a limited responsiveness of firms or inappropriate uses of government resources.

17. Another concern is that governments may end up subsidising investment or innovation that would have happened even without their help (Appelt et al., 2016[32]). This would effectively imply wasted government spending and economic rents (windfall gains) for firms. However, in practice, assessing the so-called additionality criterion remains challenging. Moreover, for green industrial policies timing may be more important than additionality. A faster reduction in greenhouse gas emissions will reduce climate related risks which depend on the accumulated stock of these gases.

18. On top of direct fiscal implications, costs refer also to market distortions and trade-offs with other policy objectives. From the perspective of a country adopting industrial policy, the main possible cost relates to inducing market distortions that negatively affect the availability, prices and quality of goods and services, as well as innovation. The level of distortions differs across types of measures but also with their design and implementation as some distortions can be unintended. In general, the highest distortions result from measures that effectively limit competition and increase protectionism, and ultimately reduce

[13] For example, based on a comprehensive review of recently implemented mission-oriented innovation policies aiming to fight against or adapt to climate change, 65% of policy initiatives include more than one mission tackling different challenges beside climate change (OECD, forthcoming[174]).

[14] These policies typically comprise a tailored set of measures, shaped by the unique economic, political, and institutional contexts both domestically and internationally. Domestic factors include industry/market-specific market dynamics, barriers to entry, and the general level of competitiveness.

contestability of markets.[15] Moreover, the fiscal costs of industrial policies must be financed and can introduce economic distortions due to higher taxation or costs due to lower government spending in other areas.

19. A recent example of market distortions from industrial policies is the imposition of a series of import tariffs on China, Mexico, Canada, the European Union and other trading patterns by the US administration in 2018.[16] This measure was motivated by protecting American jobs and increasing national security. However, the tariffs are estimated to have lowered real US income and employment, and triggered retaliatory tariffs (Amiti, Redding and Weinstein, 2019[33]; Fajgelbaum et al., 2020[34]; Oxford Economics, 2021[35]).

20. Another example of distortionary measures are local content requirements. Although they may help achieve short-term government's objective, local content requirements result in long-run inefficiencies not only in the affected sector but also in the rest of the economy (Stone, Messent and Flaig, 2015[36]; OECD, 2019[37]). These inefficiencies ultimately reduce job growth and opportunities to achieve economies of scale and to innovate.

21. Industrial policies that support specific domestic sectors can also negatively affect producers in other countries, posing challenges for the gains from international trade and competition, public support for globally integrated markets, and rules-based trade. Questions about the extent of these effects, which subsidies are the most damaging and the needed reforms to existing World Trade Organization (WTO) rules are a growing focus of attention amongst policymakers (Sykes, 2005[38]; IMF/OECD/World Bank, 2022[39]). More work is also needed to understand the impacts of subsidies, notably in a world of complex global supply chains, where identifying ultimate losers and winners from a subsidy in a given country can be challenging.

22. Negative international spillovers could be magnified if countries adopted tit-for-tat policies, including in sectors other than those initially targeted by industrial policy. Such an outcome could potentially undermine the rules-based trading system (Box 1 and Section 3.6). In contrast, industrial policies that support consumption and skills generally (like subsidies for purchases of electric vehicles or tax credits for vocational training) avoid such negative international spillovers.

23. Targeted industrial policy may be at odds with competition policies (Aiginger, 2014[40]; Aiginger and Rodrik, 2020[10]). Industrial policy frequently grants specific firms and industries preferential treatment. In contrast, competition policy, and enforcement in general, ensures a level-playing-field and focuses on consumer welfare. Tensions could arise especially with protectionist measures, which is frequently the case with national security-motivated industrial policies (see below). Trade-off considerations could be particularly relevant in the European Union. State-aid rules to ensure a level-playing-field among the EU member states could make the implementation of some industrial policies complicated (OECD, 2023[41]).[17] Still, competitive environments are conducive for the effectiveness of some industrial policy measures (Criscuolo et al., 2022[24]).

24. Debates about industrial policies have not yet been resolved in view of challenges with their evaluation and the existence of both negative and positive examples (Karp and Stevenson, 2012[42]). Still, a serious assessment of costs and benefits should be attempted to inform policy makers. It should extend

[15] A highly contestable market is one in which entry and exit barriers are low and incumbent firms face strong competitive pressures merely from a threat of new firms entering the market quickly (Schwartz, 1986[171]). Thus, incumbents must continually improve their products and services to maintain their market share. In contrast, not contestable markets have high barriers to entry, reducing competition and protecting incumbents, with negative effects on innovation, prices and consumer choice.

[16] The tariffs were levied on solar panels, washing machines, steel and aluminium, and on a broad range of products from China.

[17] The European Commission has recently eased state-aid rules for green subsidies (Annex A).

beyond measuring the short-term direct impact on the targeted sectors, firms or technologies. Analysis should focus on overall effects in the longer term, including domestic and international spillovers and on a wide range of fiscal costs (Box 1). The uncertainties surrounding the estimates of the costs and benefits calls for considering various alternative scenarios of possible outcomes.

25. The distributional impact of industrial policies across firms, households and taxpayers should also be assessed. Direct benefits of government support for firms, industries or technologies tend to be concentrated in specific firms (Meckling, 2021[43]), while their fiscal costs are shared across current and future taxpayers. As such, the ultimate economic incidence of government measures is difficult to predict. It could partly fall on consumers, especially when competition in the producing sector is high (OECD, 2020[44]; Aghion et al., 2022[45]; Bistline, Mehrotra and Wolfram, 2023[46]). Moreover, while government incentives to production in a specific sector can negatively affect competitor businesses in other countries (see above and Section 3.6), they may benefit domestic and foreign consumers. The latter effects are particularly likely when a country imports, but does not produce, a product subject to production subsidies by a foreign government.

Box 1. Selected elements of cost-benefit analysis of industrial policies

Domestic spillovers could be more important in the longer term than direct effects

Existing evidence suggests that several domestic spillovers are possible (Annex D).

- Opening factories stimulated by industrial policies could have positive local output and employment spillovers. Part of the incomes from newly established factories will be spent locally, raising labour demand and wages in local services and housing market prices (Greenstone and Moretti, 2003[47]; van Dijk, 2016[48]; Ehrlich and Seidel, 2018[49]), and may also spur additional firm creation (Kim, 2021[50]). Such local multiplier effects are estimated to be substantial (Moretti, 2010[51]; Cerqua and Pellegrini, 2020[52]). Unfortunately, little is known if these positive spillovers are net gains for the country as a whole and if they lead to crowding out of employment and investment in industries or regions which are not targeted by public support.[1]
- Negative spillovers to the whole economy could arise if the cost of domestically produced goods supported by industrial policy is significantly higher than the cost of imported ones, and imports are inhibited by accompanying protectionist policies. This would imply higher prices for domestic households and businesses that consume these goods or use them as intermediate inputs. Such concerns are legitimate in industries where initial production costs differences are particularly large, such as for many green goods.[2] While some price convergence is likely due to learning-by-doing and scale effects, the transition period could be long, and convergence could be incomplete.

Fiscal implications should be accounted for in a comprehensive manner

Both direct and indirect fiscal costs and benefits should be considered. Direct fiscal costs can be estimated relatively precisely in most cases, such as one-off government grants to a given industry, or a (recurrent) annual budget for supporting innovation. In contrast, there is more uncertainty about the costing of subsidies related to the quantity of consumption or production and to the take-up of subsidised loans.[3] Indirect fiscal benefits could include higher tax revenue if industrial policy has positive total economy effects or when the industrial policy reduces negative externalities. In these cases, the effects would lower related public spending and prevent a decline in revenue. For instance, savings would be realised if climate change was arrested/reversed, requiring less public spending on green policies, adaptation measures and compensation of climate-related economic damages. Fewer

climate-related disruptions would also imply higher government revenue. These indirect fiscal effects are inherently difficult to estimate, given compounding of uncertainty via second-round effects.

Fiscal contingent liabilities should also be taken into account. They can arise from credit guarantees or if the promoted industries require extra government support to cover protracted financial losses.[4] Policy makers may prefer to use credit guarantees when pursuing industrial policy, especially when the required funding is high, as the guarantees do not have immediate budgetary costs. However, they may still have a budgetary impact in the future. Estimating such contingent liabilities is even more challenging and uncertain than other indirect fiscal effects. This is due to a wide range of potential outcomes, each with its associated costs and probabilities, which are difficult to determine *ex ante* (Moretti, Boucher and Giannini, 2021[53]).

Global spillovers could also matter

There is uncertainty about the balance of positive and negative global effects, which varies across specific measures and depends on their design and implementation. Positive global spillovers could arise due to technology and learning spillovers (Bown and Clausing, 2023[54]). Industrial policy-induced development of new technologies or production capacity could lead to wider availability and lower prices of products. These outcomes could stem from learning-by-doing and scale effects. In the case of green industrial policy, GHG emission reductions would have also positive externalities for the global economy. However, negative spillovers are also possible. Government incentives to set up and run businesses in a country could imply that employment and investment are relocated from other economies. Such a zero-sum game is particularly likely in the presence of winner-takes-all dynamics and when a large-scale public support eliminates foreign competition.

Another risk of negative spillovers from industrial policies is triggering tit-for-tat policies, leading to severe distortions to competition and production overcapacity as well as less integrated global economy (Crowe and Rawdanowicz, 2023[55]). For instance, several model simulations considering different re-shoring scenarios, achieved via trade protectionist measures, indicate clearly significant welfare losses (D'Aguanno et al., 2021[56]; Eppinger et al., 2021[57]; Arriola et al., 2020[58]; Sandkamp, 2022[59]). Moreover, inward-oriented policies could reduce knowledge spillovers and academic co-operation, with negative consequences for technological progress and productivity growth (Cerdeiro et al., 2021[115]; Góes et al., 2022[116]).

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1. For instance, place-based policies in Europe had some negative local displacement effects, with employment gains in a targeted area being at least partially offset by losses in neighbouring untreated areas (Einiö and Overman, 2016[60]; Ehrlich and Overman, 2020[61]). In contrast, the evidence from placed-based subsidies in Türkiye introduced 2012 suggest that spillovers via domestic trade and migration benefited firms and individuals outside targeted areas (Atalay et al., 2023[62]). This partially undermined the objective of reducing regional income inequality.
2. According to market analysts' estimates, the cost of some manufacturing in advanced economies could be sizeably higher than in China. For instance, costs of manufacturing of several key components of solar panels in China are 10% lower than in India, 20% lower than in the United States and 35% lower than in Europe (IEA, 2022[30]). Similarly, Chinese wind turbines are half the price of the global average (Blackburne, 2022[63]).
3. For instance, the range of estimated costs of the US tax credits in the IRA is very wide (Bistline, Mehrotra and Wolfram, 2023[46]). The highest is almost three times larger than the lowest estimate. This reflects the fact that most of the credits are uncapped and that their use by households and firms is uncertain.
4. Loan guarantees are a common measure across OECD countries (OECD, 2023[3]; Criscuolo et al., 2023[1]). The bankruptcy of Solyndra – a solar cell producing company in the United States – is an illustrative example of contingent liabilities. The US government provided USD 535 million loan guarantees to Solyndra in September 2009, and three years later the company filed for Chapter 11 bankruptcy protection (US Department of Energy, 2015[64]).

3.3. Pros *and* cons *of industrial policies differ across specific objectives*

26. Governments should intervene primarily where existing market failures cannot be addressed solely by markets and other government policies and where these failures clearly imply large social, economic and environmental costs. In contrast, policies that are less likely to achieve their stated objectives and are highly distortive should be avoided. Some objectives are less controversial than others, such as future and welfare-oriented industrial policies that can address important economic, social and environmental challenges (Aiginger and Rodrik, 2020[10]).

3.3.1. Green industrial policies

27. The main arguments for green industrial policies aimed at reducing GHG emissions are potentially huge social and economic costs of inaction, calling for a rapid and large-scale adoption of clean technologies (Rodrik, 2014[29]; Cervantes et al., 2023[17]). Climate change poses significant threats to populations and economies around the world (OECD, 2021[65]; OECD, 2022[66]). Progress with the green transition has been slow and there is an urgency to reduce global GHG emissions (IPCC, 2023[67]). This goal is unlikely to be met without government help due to several market failures.

28. The rationale for such intervention is stronger if no other – or only partially effective – green policies are implemented. For instance, in some countries, carbon pricing is difficult to apply for political reasons.[18] In other countries, existing carbon prices are not high enough or do not cover many activities (OECD, 2021[68]).[19] Moreover, there could be synergies between green industrial policies and carbon taxes (Anderson et al., 2021[69]; Cervantes et al., 2023[17]). In particular, lowering the costs of low-carbon technologies could increase the responsiveness of emissions to carbon prices, especially if combined with regulations and standards.

29. Green industrial policies are more likely to be politically acceptable than policies that effectively concentrate the costs on polluters. Nevertheless, the ultimate economic incidence of industrial policy financial incentives is difficult to predict. For instance, industrial policies supporting production or technology development benefit specific firms. Still, they could partly fall on consumers in the form of lower prices. Consumer distributional effects could also vary across income groups. Initially, the consumption of supported technologies (for instance electric cars and solar panels) and thus the associated financial benefits are likely to be skewed towards higher-income households, given elevated prices of newly introduced green technologies. However, over time when the technologies become more affordable (Way et al., 2022[70]; IEA, 2023[71]), the benefits are likely to accrue increasingly to lower-income households.[20]

30. Green industrial policies are also likely to have international distributional consequences. Their adoption in advanced economies, especially in the case of green policies, is sometimes criticised for undermining the growth and adoption of green technologies in emerging-market and developing economies (Kaufman, Saha and Bataille, 2023[72]). Indeed, given the ongoing policy support, green

[18] For exemple, Dechezleprêtre et al. (2022[188]) find that targeted investment programmes or policies centred around regulations (such as bans on polluting vehicles from city centres or dense areas, and the mandatory insulation of buildings) are more widely accepted by society than policies based on price mechanisms, which are perceived as inequitable.

[19] Estimates of global carbon prices aligned with global objectives vary widely but a common view is that they should be at least above EUR 40 per ton of CO_2 today and climb far above EUR 100 by 2060 (OECD, 2021[101]). However, on average in the OECD in 2018, two-thirds of emissions were priced below EUR 30 per ton, and 30% of emissions were not priced at all.

[20] Lower-income households spend a higher share of their consumption and income on electricity and fuel (Causa et al., 2022[162]). Thus, if the adoption of green technologies (including electric cars) eventually brings savings on these consumption items, compared with the current situation, lower-income households will benefit proportionally more than higher-income ones.

transition in advanced economies can be much faster in the near term than in lower-income economies. However, over time, the developing countries – where most future emissions growth is expected to continue – can benefit via the availability of cheaper technologies (Cervantes et al., 2023[17]).[21]

31. The justification for industrial policies to back green technology development is strong.[22] Reaching the net zero GHG emissions targets will not be possible without the development of new technologies (IEA, 2021[73]; IEA, 2023[71]).[23] Innovation is crucial for reducing the costs of carbon-free technologies to become competitive with current high-carbon alternatives. Supporting these technologies could be justified also by positive domestic and international spillovers, including to less-developed countries. Industrial policies should prioritise supporting R&D, especially for early stages of clean technologies where market failures result in barriers to development (Cervantes et al., 2023[17]). The selection of specific technologies should account for their potential to reduce GHG emissions and to lower costs of employing these technologies (so that they can be widely adopted), for spillover effects on other green technologies, and complementarity with the existing infrastructure.

32. Prioritising the consumption or production of green technologies has both *pros* and *cons*, without a clear advantage for either approach. Reductions in GHG emissions crucially depend on a fast and widespread adoption of green technologies. The speed and extent of adoption are a function of their prices. The lower the prices, the higher their take-up. The effect of both consumption and production subsidies on final consumer prices is uncertain. Prices may not fall if producers increase prices to match consumption subsidies or if they maintain prices when receiving production subsidies. Strong competitive pressures are likely to minimise such outcomes. With subsidies to consumption, the price signals could operate faster than in the case of subsidies to production. Subsidising consumption could also raise fewer competition concerns, including related to international trade rules, than supporting production. For a given technology, consumption subsidies would let market forces stimulate supply and innovation, without a need to choose specific producers. However, when limited supply impedes the adoption of green technologies, subsidising production could be desirable too (Boushey, 2023[74]). This is the case when the cost of setting up new production is high and returns on investment are uncertain due to difficult to predict demand and competitive pressures from other producers or alternative technologies. Subsiding output also makes sense when learning-by-doing and economy-of-scale effects are expected to lower production costs significantly.

33. In principle, both consumption and production subsidies should be technology neutral, to avoid picking winning technologies. However, for a given amount of fiscal resources, spreading support on too many technologies may dampen price signals. Moreover, in practice it may be more difficult to design and monitor support to a large pool of technologies. In some cases, strong network effects argue for supporting fewer technologies to maximise the effectiveness of subsides.

34. Protectionist measures to achieve environmental objectives can be particularly counter-productive by making the green transition longer and more expensive and by alienating key trade partners. For

[21] As it happened with other technologies. For example, increasingly cheaper mobile telephony allowed many developing countries to leapfrog fixed-line technology, benefiting livelihoods and productivity (Dahlman, Mealy and Wermelinger, 2016[164]).

[22] Government intervention is sometimes justified to change the direction of innovation. Acemoglu (2023[180]), building on the directed technological change framework (Acemoglu, 1998[169]; Acemoglu, 2002[168]), provides a general model to analyse factors that can lead to misalignment between market incentives and social objectives, including preventing climate change. The model shows that in the presence of markup differences, externalities and other social considerations, the equilibrium direction of innovation can be distorted, which could justify government intervention to correct these distortions. In the case of green technologies, innovation tends to be path dependent, favouring socially-suboptimal "dirty" innovation. This calls for government intervention (Aghion, Boulanger and Cohen, 2011[183]).

[23] IEA (2023[71]) estimates that 80% of technologies are available to meet the 2030 GHG emission targets, while the percentage drops to 65% for the 2050 targets.

instance, local content requirements have been used as a part of green industrial polices, including in solar and wind energy industries (OECD, 2015[75]). They were found to have mixed or negative effects on local job creation, value added and technology transfer in solar panels and wind-energy sectors. In addition, they can reduce international competition and foreign direct investment, leading to higher costs of inputs for downstream businesses. Finally, protectionist measures may limit achieving a sufficiently large scale of production with negative implications on the expected decline in prices (OECD, 2023[76]). Thus, ultimately, such measures risk failing in the stated climate objectives. Ideally, responses to climate change, including via industrial policies, should be co-ordinated internationally to avoid negative spillovers and to ensure effectiveness and fairness.

3.3.2. National-security motivated industrial policies

35. Economic activity, especially in the manufacturing sector, has always been intertwined with national security as many goods and technologies can have both military and commercial uses. However, in recent decades, national security risks expanded substantially, moving from purely military considerations to areas such as natural disasters, cybersecurity, infectious diseases, climate change and international trade and investment (Murphy and Topel, 2013[77]; Heath, 2020[78]).[24] In this context, national security risks could relate to situations when the unavailability of certain components or final products, like critical minerals, energy, pharmaceuticals and semiconductors, or of advanced technologies (like artificial intelligence) may threaten the economic, health or military security of a country.

36. Ensuring national security is an important government objective but achieving it by limiting or modifying foreign exposures with the help of industrial policy risks being ineffective and costly. The Russian war of aggression against Ukraine has clearly highlighted that economic dependencies can be exploited to undermine the economic and national security of adversaries. However, in practice, it is difficult to know what degree of economic exposures is safe and sufficient to minimise potential economic costs. Consequently, quantifying *ex-ante* economic costs, benefits and effectiveness of industrial policy targeted at national security is difficult.

37. In general, two polar solutions are possible.

- The first is to maintain *status quo* and deal with economic consequences of geopolitical conflicts once they materialise. Such an approach could turn out to be very costly in case of prolonged geopolitical conflicts or wars. However, it could avoid costs of measures to minimise such risks.
- The second is to eliminate foreign trade exposures with the help of industrial and trade policy measures. These could subsidise production, at home and among allied nations, or penalise imports from geopolitical rivals. This solution is likely to be economically costly and lead to trade conflicts. Similarly, restricting transfers of dual-use (military and civil) technologies to and from geopolitical rivals could adversely affect welfare by curbing international competition and knowledge spillovers. Moreover, in a highly integrated global economy with a large degree of specialisation in some sectors, achieving full autonomy will be difficult. In some cases, including for natural resources and in small countries, it will be impossible. While re-shoring or friend-shoring production from geopolitical rivals can reduce the dependency on final products (like batteries or solar panels), it could introduce dependencies on imported intermediate inputs (Crowe and Rawdanowicz, 2023[55]). These strategies could also increase indirect trade exposures via main trading partners if these partners increase their imports with geopolitical rivals.[25] Similarly,

[24] The increasing multipolarity of the world economy, the rise of state capitalism and growing concerns about resource scarcity have been among the key factors behind these developments (Thirlwell, 2010[185]).

[25] For instance, in recent years, the United States have reduced imports from China and increased imports from other countries such as Vietnam and Mexico (Alfaro and Chor, 2023[181]; Koh, MacLeod and Rusticelli, 2023[191]). However,

technology restrictions, especially if taken unilaterally, may be circumvented and thus prove ineffective in ensuring national security objectives.[26]

38. In practice, many countries choose an intermediate solution by focusing on selected critical products or sectors. To minimise the greatest national security risks and the economic costs of reducing foreign trade exposures, the selection of these products should be based on well-grounded analysis. It should account for the importance of a given product for military, economic and health security; import dependence and concentration; and the possibility for substitution with similar products or the same product from other domestic or foreign sources. Evidence from the OECD suggests that goods that are critical for the domestic economy given their input-output linkages and that are sourced primarily from abroad account for a small share of the OECD output (Schwellnus et al., 2023[79]). This is consistent with similar analyses in the European Union and the United States (European Commission, 2021[80]; The White House, 2022[81]). Consequently, national security justifications should not be applied widely to many products and sectors.

3.3.3. Place-based industrial policies

39. One of the goals often put forward in recent industrial policy initiatives adopted across countries is to favour inclusiveness and boost the supply of high-quality jobs (European Commission, 2023[82]; The White House, 2022[83]). This concern partly stems from globalisation contributing to a decline in employment in manufacturing sectors in many advanced economies, which used to be a major provider of stable jobs for workers in the middle of the skills distribution (Sorbe, Gal and Millot, 2018[84]; Green, 2019[85]).

40. Regions have been unevenly affected by these disruptions, which can motivate place-based industrial policy strategies. These strategies seek to reshape the geographical distribution of industrial activity by encouraging the development of industry in particular places (Annex B). Thus, they could address inclusiveness, fairness and/or equality objectives and could foster equitable economic development in countries with large regional disparities (Muro et al., 2022[86]; Criscuolo et al., 2022[23]; Muro, 2023[87]). Their potential advantage is to address more directly and efficiently the local roots of market failures. For instance, past empirical research has found evidence about positive effects of fiscal support on employment or investment of targeted firms (Annex D).

41. However, several considerations may call for caution when implementing industrial policy for inclusiveness purposes:

- Positive effects of place-based public support to firms may come at the expense of productivity performance (Bernini and Pellegrini, 2011[88]; Branstetter, Li and Ren, 2022[89]).
- Compared with past experiences, industrial policies envisaged in advanced economies may be geared to highly-capital intensive sectors, where employment gains could be moderate.[27]

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the latter countries have seen an increase in imports and investments from China. Thus, the United States remain indirectly dependent on China through its trade and GVC links with the third-party countries.

[26] The history of using export controls during the Cold War shows that uncoordinated efforts to limit access for geopolitical adversaries to technologies that are important for military uses were futile (Bown, 2023[186]).

[27] More research is needed on employment opportunities associated with the deployment of renewable energy technology, where available estimates tend to be uncertain (Cameron and van der Zwaan, 2015[161]). Estimates should take into account jobs related to different stages of production (manufacturing, installation and maintenance), as well as indirectly related jobs. The distribution of jobs across these different stages of production is likely to vary across technologies, as well as the distribution of occupations, wages and educational requirement associated with specific jobs. For example, recent research on job creation linked to the development of clean energy sectors shows that jobs in the solar panels sector are mostly in sales occupations, while jobs in the wind turbines sector are most represented among installation and maintenance occupations (Curtis and Marinescu, 2022[187]).

- Protecting jobs in specific sectors can be very costly for consumers, especially when industrial policy is based on protectionist trade measures (Hufbauer and Jung, 2021[90]).[28] Moreover, financial incentives to create jobs, such as tax credits and government grants to firms, can be costly and not very effective compared with measures to support locally other business inputs, including customised public services and infrastructure (Bartik, 2020[91]).
- In sectors requiring highly specialised skills, which are likely to be in short supply in specific locations, fiscal support could lead to inflationary effects on wages rather than employment gains in the short run (Criscuolo et al., 2022[24]). These negative effects are more probable if support is sizeable and short-lived.

3.4. Which policy measures to use?

42. Measures should be tailored to specific problems. Identifying the main causes of market and co-ordination failures is crucial for deciding on specific effective measures of industrial policy. Strategic collaboration and co-ordination between the private sector and the government could facilitate identifying the most significant bottlenecks and opportunities (Rodrik, 2014[29]; Juhász, Lane and Rodrik, 2023[4]). Several options of such collaboration have been proposed, but they involve implementation challenges and there are not many examples of their successful operation in practice.[29] As co-ordination failures are context-specific, it is difficult to formulate policy guidelines, even general ones, for dealing with them (Karp and Stevenson, 2012[42]).

43. In principle, governments face a choice between improving general business conditions and implementing targeted measures supporting specific industries and technologies. Both have advantages and disadvantages. In some cases, however, there could be some complementarities.

- The first type of measures includes policies that provide incentives for economic growth and encompass different policy areas (Annex B; Criscuolo et al. (2022[23])). They include policies to ensure a sufficient and stable supply of key factors of production, including skilled workers and financing; predictable legal frameworks, including for competition; appropriate infrastructure; and sufficient incentives for innovation (OECD, 2023[92]). They avoid the pitfalls of targeted measures related to the ability to pick winners, capture and rent seeking. They also are less likely to distort competition and lead to market dominance by supported companies.
- Targeted measures usually involve economic incentives in the form of production, R&D and credit subsidies, loan guarantees, and innovation-oriented public procurement.[30] Improving general business conditions may not be enough to boost activity in a given sector due to sector-specific market failures (Terzi, Singh and Sherwood, 2022[2]). For instance, general incentives to R&D are not likely to be effective in stimulating sufficient innovation in green technologies which often

[28] In the United States, protectionist measures for the steel industry, textiles and apparel saved jobs at consumer costs upwards of $500,000 per job year, without industries becoming truly competitive in world markets (Hufbauer and Jung, 2021[90]).

[29] They could involve the Japanese style deliberation councils (Okazaki, 2000[184]), but also supplier development forums, search networks, investment advisory councils, sectoral round-tables, diaspora associations and private-public venture funds (Rodrik, 2009[167]). Romer (1993[170]) also proposed self-organising industry investment boards whose aim is to propose a public provision of specific inputs – including R&D or infrastructure – to their industry. The idea implied that such boards submit their proposals to the government, and when approved, the project is financed by a tax levied on the sales of the industry.

[30] Table 1 in OECD (2023[3]) provides a comprehensive taxonomy of government support measures, categorised according to their formal incidence (identifying to whom or what the transfer is first given, e.g. enterprise income, labour, consumption) and their transfer mechanism (how the transfer is generated, e.g. in the form of direct cash transfers or tax revenue foregone). See Annex B for more details on this taxonomy.

operate in highly regulated sectors. Targeted measures could cost taxpayers less, can be easier to monitor.

- Still, framework conditions are key in enabling that the most productive firms grow and represent an important channel for structural change, as they may disproportionately affect key sectors (Aiginger and Rodrik, 2020[10]; Criscuolo et al., 2022[24]). Moreover, better regulatory frameworks that reduce barriers to entry and expansion could increase the effectiveness of targeted policies. Competitive environments also help ensure that government support to specific industries or firms will be shared with consumers more broadly (Criscuolo et al., 2022[24]).

44. Regarding the green transition, improved framework conditions could have several additional benefits. For instance, they could reduce uncertainty by promoting international standardisation, infrastructure provision and sound regulatory standards (Cammeraat, Dechezleprêtre and Lalanne, 2022[93]). Improved regulation to facilitate entry and scaling up of green technologies, including through the use of regulatory sandboxes, together with a wider use of green procurement,[31] could also help accelerate the green transition (Kleimann et al., 2023[94]; OECD, 2023[76]).

45. A comprehensive strategy is likely to be more effective in solving market failures than single measures. For instance, stimulating domestic production in certain sectors by grants, tax credits or loan guarantees can be ineffective or very slow if required investment and production inputs are not available. In some cases, building factories and sustaining large-scale production require skilled labour and specialised machines and inputs.[32] Thus, effective industrial policies should try to address the main bottlenecks, including along supply chains, and take a whole-of-government approach to their design, building a package that can deliver synergies across government policies.

46. Governments could explore the desirability of adding conditions related to social and environmental goals to the provision of support to private businesses within the framework of industrial policies. These actions can enhance the alignment of various government policies and the efficacy of incentives in achieving the stated objectives. Such conditionalities can take various forms, primarily related to behaviour of the firms targeted by industrial policies (Mazzucato and Rodrik, 2023[95]). They include ensuring equitable and affordable access to the resulting products and services; directing activities toward sociably desirable goals, including the creation of high-quality jobs; sharing financial returns; and requiring reinvestment of profits into productive activities. Several of them have already been adopted in practice. For instance, a requirement for meeting specific labour standards was used in the United States and for reducing GHG emissions in France.[33] Nonetheless, they may introduce complexities in the administration of industrial policy programmes, particularly when it comes to monitoring of compliance with these

[31] Green public procurement (GPP) corresponds to the public purchasing of products and services that are less environmentally damaging when taking into account their whole life cycle. Many countries have developed and adopted GPP strategies and policies. According to an OECD 2022 survey, 32 out of 34 surveyed OECD countries had an active national GPP policy or framework (OECD, 2023[179]).

[32] For instance, in the United States in the context of expanding digital sector, 67,000 jobs for technicians, computer scientists, engineers in semiconductor industry risk going unfilled by 2030 (SIA, 2023[192]). A shortage of skilled labour has already allegedly resulted in delays with constructing TSMC's semiconductor plants in Arizona (Alfaro and Chor, 2023[181]). Similarly, producing solar panels requires high-quality silicon inputs and it takes more than two years to build polysilicon factory, which may delay achieving full production capacity (BloombergNEF, 2023[163]).

[33] In the United States, the IRA envisages substantial adders for tax credits for projects that are located in high-unemployment or energy communities (the later refer to communities with high employment in and high local tax revenues from the fossil fuel industries), and meet certain labour requirements (related to the level of wages paid during construction and repair and to having apprentices) (Bistline, Mehrotra and Wolfram (2023[46]); Annex A). In France, the government bailout of Air France was conditioned on a CO_2 emission reduction strategy (Meckling, 2021[43]).

conditions. The intricacies of administration could also potentially deter some firms from participating in these programmes.

3.5. Evidence-based design and implementation of industrial policies could minimise risks of failures but not eliminate them

47. Despite economic, political, social and environmental desirability of some industrial policies, designing and implementing them to maximise benefits and minimise costs prove difficult in practice (Juhász, Lane and Rodrik, 2023[4]). This relates to imperfect knowledge of government, private capture of public aid and to political interests trumping economic motivations in choosing industrial policies (Tirole, 2019[96]). Evidence-based design and implementation of industrial policies could minimise such risks but not eliminate them (OECD, 2020[44]). In this context, several aspects require serious considerations.

48. When targeted measures are needed, several factors argue for limiting their amount and time they are in place. Unlimited support is more prone to abuse and complicates costing. Automatic sunset clauses that require positive action to renew support schemes could help limit such abuses (Rodrik, 2014[29]; OECD, 2020[44]; IMF/OECD/World Bank, 2022[39]). They could strengthen the monitoring of targets and the accountability of decision makers. If targets are not met, any extension of support should require clearly, publicly available, explanations for such actions. However, such clauses are not a panacea. Experience with some industrial policy programmes in the United States shows that legislators and bureaucrats sustained funding and protectionist measures despite clear and long-standing signs of failures (Atkinson, Cohen and Noll, 1992[97]).

49. Longer horizons of government support may be necessary to provide sufficient time to be effective in incentivising change. This is particularly needed when implementation takes time, as with large-scale physical investment, and when future demand conditions are highly uncertain. In these cases, ensuring a longer horizon of help can signal government commitment and reduce uncertainty (Karp and Stevenson, 2012[42]). Moreover, longer horizons are advisable with industrial policies involving large amounts of funding targeted at narrow sectors. This could help minimise potential resource constrains and associated price pressures.

50. The government decision-making process to select specific firms and technologies targeted by industrial policies should be competitive, transparent and avoid favouring incumbents and discouraging new entrants (Warwick and Nolan, 2014[18]; OECD, 2023[76]). However, there can be tensions between the need to encourage new entrants and the desire to provide scarce resources to incumbents with proven track record. This tension is evident in the context of grants and below-market financing to firms in specialised sectors, and underscores the need for caution with such instruments (OECD, 2023[3]). To ensure such outcomes, the selection process could be delegated to independent and expert institutions, ideally with a well-established reputation, that are capable of undertaking technical evaluations of projects and can be shielded from political pressure (Rodrik, 2014[29]). This should be balanced against potential concerns about democratic legitimacy with technocrats having sway over important public spending. The institutions could be either government investment banks/funds or dedicated mission-oriented agencies, like the US Defence Advanced Research Project Agency (DARPA) or publicly capitalised green investment banks (OECD, 2016[98]).[34] Their role should involve “smart” searching for nascent economic activities and not just providing credit (Aiginger and Rodrik, 2020[10]). There are some arguments that government

[34] The DARPA was established at the end of the 1950s. Its mission has been to make pivotal investments in breakthrough technologies for national security. It contributed to development of game-changing military capabilities but also to inventions for modern civilian use like the Internet, automated voice recognition and language translation, and Global Positioning System receivers. DARPA’s programmes are managed by highly qualified managers. It does not have a formal independence. However, it gained a reputation and political insulation for its professional competence and repeated successes (Greenwald, 2013[189]; Rodrik, 2014[29]).

officials involved in industrial policy implementation should have experience of business and deeper research, evaluation skills, connections to the academic sector, and a work culture oriented towards learning (Bakhshi, Freeman and Potts, 2011[99]). However, diligence should be exercised to mitigate conflict-of-interest risks for officials with business experience, as is the case in other public institutions, including financial supervision.

51. Risks of private capture by well-connected and resourced business can be reduced by building sunset clauses and claw-back arrangements, together with clear and well-specified performance indicators, into industrial policy measures (OECD, 2020[44]). Claw-back measures stipulate that financial support must be returned if the beneficiary does not meet agreed objectives. This is a very strong disciplining device, but it may also deter businesses from participating in industrial policy programmes. However, in some manufacturing sectors with highly concentrated production, private capture may be difficult to avoid as policy support will inevitably benefit large players.

52. Decisions to terminate government help for unsuccessful projects are difficult to make but are essential for minimising the costs of industrial policies. Failures of individual projects should not be necessarily viewed as a failure in general and it is a natural part of government intervention (Rodrik, 2014[29]). Thus, to facilitate such decisions a set of institutional safeguards is needed (Rodrik, 2014[29]; Juhász, Lane and Rodrik, 2023[4]; OECD, 2023[76]). They could include clear benchmarks, close monitoring (which faces many similar challenges with *ex-post* evaluation), and explicit mechanisms for reversing course. Moreover, the less political capital is invested in specific industrial projects and the more they are run by independent and expert institutions, the easier it could be to withdraw support.

53. Simple rules and efficient administration of government aid to the private sector are important too. They can maximise the take-up by firms, especially smaller ones with fewer resources to deal with administrative requirements. For instance, testimonies indicate that some businesses praised the relative simplicity of the latest measures in the IRA packages in the United States (Annex A), while others complained about the patchy regulatory framework and complex processes for accessing multiple pots of money in the European Union.

54. *Ex-post* evaluations can help discipline stakeholders in minimising costs of industrial policies. The awareness of *ex-post* audits could minimise wasteful spending but also offer a tool for learning what works and a way of improving policy in complex and uncertain environments (Bakhshi, Freeman and Potts, 2011[99]). Thus, mandating evaluations of industrial policy or committing to evaluations, at the highest possible level, are recommended (Warwick and Nolan, 2014[18]). The results of evaluations should be fully disclosed.

55. There are several approaches to evaluate industrial policy and no single and generalised evaluation framework is superior. However, useful evaluations should involve several elements (Warwick and Nolan, 2014[18]; Rodrik, 2014[29]).

- Being clear about the objectives and the policy rationale is indispensable for any programme evaluation. In this respect, setting too many general objectives makes the evaluation more challenging and reduces chances of identifying failures (Rodrik, 2014[29]). The multiplicity of objectives could also result in cherry-picking of objectives that have been achieved to claim success but ignoring the ones that have not been attained.
- It is also recommended to prepare a well-defined evaluation strategy *ex ante* and ensure that data necessary to undertake it are collected (Warwick and Nolan, 2014[18]).
- Evaluation should be objective and free of political influence. Thus, it is desirable that programmes should be evaluated by, or in collaboration with, genuinely independent experts.
- In general, achieving objectives related to technology development is more difficult to measure than for jobs or profitability objectives. In this case, *ex-ante* costs or productivity targets could be established (Rodrik, 2014[29]; OECD, 2023[76]). While they are not easy to set in practice and cannot

account for unforeseen events, significant deviations from them could still act as triggers for a careful evaluation to decide whether to maintain or abandon the policy.

3.6. How should countries respond to industrial policies implemented in other countries?

56. The implementation of industrial policies by other countries raises the question of an appropriate response. Indeed, in reaction to the US industrial policies – the CHIPS and Science Act and the IRA, many advanced economies have come up with similar measures, threatening a start of a subsidy race (Clausing and Wolfram (2023[100]), Annex A). This was mainly motivated by the fear of losing productive activities (and associated investment, expertise and critical inputs) and competitiveness concerns.[35]

57. The appropriate response should depend on the expected effects of industrial policies by foreign countries (see above), net benefits of retaliatory measures, strategic objectives and on pragmatic considerations.

58. Non-discriminatory industrial policy measures adopted abroad, like some subsidies for consumption and the pre-commercial development of technology, in principle do not warrant any tit-for-tat response as they would likely involve positive spillovers. In contrast, if other countries adopt policies that give them an advantage over businesses in other jurisdictions, countries may wish to act. They should consider potential costs of losing domestic businesses and of a subsidy race against potential benefits of having access to lower-cost imported products for domestic buyers. For instance, for countries that principally import targeted goods, the costs of losing domestic businesses could be small, while the benefits in terms of availability of cheaper goods that are important for domestic economic policy objectives (like the reduction in GHG emissions) high. A subsidy race risks being costly and ineffective. A concerted – but uncoordinated – policy support could result in overcapacity and ultimately undermine the viability of some factories, especially if it leads to duplication of sizeable, fixed costs. A general resort to protectionism will be negative for the global economy and could impair international co-operation (Crowe and Rawdanowicz, 2023[55]).

59. The recently expanding range and scale of government targeted support have already strained the multilateral rules-based trading system (Bown and Hillman, 2019[101]). This situation calls for strengthening trade rules. Dialog in international fora, including at the OECD, could facilitate agreeing on such contentious reforms. Greater transparency in government support, notably in industrial sectors, is an essential first step for discussing such reforms. This could be supported by agreeing on common definitions of industrial policies and reporting standards, with international institutions helping to objectively scrutinise the data and put peer pressures on countries to share data. This can underpin intensified efforts at dialogue and co-operation to better understand the impacts and effective design of industrial policies.

60. The OECD has made headway in filling the data gaps. Government help in agriculture, fisheries and energy has been already quite well measured (OECD, 2022[102]; OECD, 2022[103]; OECD, 2023[104]). Recently, the OECD collected data about industrial policies in many other sectors. Through the QuIS project and sectoral studies for selected industries, the OECD has gathered harmonised data that facilitate the benchmarking of industrial strategies across countries in terms of industrial policy expenditures, priorities, instruments and recipients (see above; Criscuolo et al. (2023[1]); OECD (2023[3])).

61. Pragmatic considerations include factors such as relative market size and available fiscal space. Small and less affluent countries can find it particularly challenging to compete in industrial policies with large and rich nations. Sometimes financial incentives granted by big economies to individual firms cannot

[35] For instance, after the IRA had been passed in the United States, Tesla – an electric car producer – announced that it would move a battery manufacturing facility from Germany to the United States (Clausing and Wolfram, 2023[100]).

be matched by small, even if rich, nations, making investments with sizeable, fixed costs less likely. Small countries may also face challenges in attaining sufficient economies of scale (unless they export most of their production) and resource constraints, including skilled labour. Developing large industries in small countries may also make their economies less diversified and thus less resilient. However, in some cases, small and less affluent economies may seize the opportunity and look for complementarities. For example, these complementarities may lie along the supply chain, building on their respective comparative advantages, including in services and technology sectors. They could also co-ordinate industrial policies among a group of countries with similar interests and characteristics.

62. The ability to use industrial policies could be also significantly constrained by large budget deficits and high levels of public debt.[36] In many OECD countries, government debt ratcheted up to high levels following a series of economic crises, and sizeable fiscal pressures (related to population ageing and challenges from climate change) are looming large (Rawdanowicz et al., 2021[105]). Tight budget constraints make prioritisation of policy areas particularly important. In these countries, the motivation for adopting industrial policies should be well justified and specific measures carefully selected.

4. Conclusions

63. Many governments around the world have actively provided various forms of support to industries over recent decades, though with different intensity across time and countries. Industrial policies are back in vogue in some advanced economies, mainly motivated by higher geopolitical risks and the imperative to accelerate the green transition. Despite well-grounded economic, social and environmental justifications for some industrial policies, there are legitimate concerns that the benefits of some of these policies could be limited and the costs high. This mainly relates to measures curbing competition and the practical and political challenges in designing and implementing effective measures. Current and future fiscal challenges and slow productivity growth in many OECD countries make efficiency and cost-benefit concerns pertinent. Thus, while governments may want to experiment with future and welfare-oriented industrial policies, they should exert moderation in scope, exercise caution in design and implementation, and be mindful of possible negative international implications that can undermine the rules-based trading system.

64. While our understanding of industrial policies is imperfect and continues to evolve with new data and evidence, basic principles inform tentative policy guidelines for governments planning to use targeted industrial policies:

- Be clear and realistic about what they are trying to achieve. Industrial policies can help to deliver urgent climate objectives, improve economic security and resilience, and support distributional outcomes, but to a varying extent.
- Prioritise areas where existing structural challenges cannot be addressed solely by markets and other government policies and where these challenges imply high and growing societal costs. Consider whether industrial policies are effective and efficient to pursue those objectives, and what other government policies will be needed for the full range of expected benefits to be achieved.
- Design tailored, proportionate and comprehensive measures based on the diagnosis of main problems and experience. This will help to boost benefits and to minimise the economic and fiscal costs, both domestically and internationally. Favour measures that:
  - do not restrict competition and encourage the development of markets and new entrants rather than favouring incumbents.

[36] For instance, in the United States, there are already signs that actual spending is less than was authorised in the CHIPS and Science Act (Hourihan, Muro and Roberts Chapman, 2023[190]).

  - minimise negative spillovers on international markets and help promote international co-operation and rules-based trade.
  - are limited in time and size, using for example sunset clauses and claw-back arrangements. Still, ensure that policies are sufficiently persistent and predictable to be able to change the behaviour of firms and individuals, including by clear and consistent messaging on the duration and terms of policies.
  - are transparent to enable public debate and independent analysis as well as to protect against domestic capture.
  - incorporate evaluation from the start. Ensure that data necessary to undertake it are collected. Establish regular review and feedback mechanisms and adapt policies as you learn. Introduce institutional safeguards for ending the government support where objectives are not being achieved or unintended consequences alter the cost-benefit assessment of programmes.
  - ensure a competitive, non-discriminatory and transparent design of the selection process of businesses to be helped, to avoid favouring incumbents and deterring new entrants. Consider delegating such selection processes to expert institutions free from political pressures, while safeguarding democratic oversight and accountability.
- Work with stakeholders when identifying the main obstacles to achieving the policy objectives as well as the need for and appropriate design of industrial policy measures, including to mobilise public support.

References

Abadie, A. (2021), "Using Synthetic Controls: Feasibility, Data Requirements, and Methodological Aspects", *Journal of Economic Literature*, Vol. 59/2, pp. 391-425, https://doi.org/10.1257/jel.20191450. [166]

Acemoglu, D. (2023), "Distorted Innovation: Does the Market Get the Direction of Technology Right?", *NBER Working Papers*, No. 30922, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w30922. [180]

Acemoglu, D. (2002), "Directed Technical Change", *Review of Economic Studies*, Vol. 69/4, pp. 781-809, https://doi.org/10.1111/1467-937x.00226. [168]

Acemoglu, D. (1998), "Why Do New Technologies Complement Skills? Directed Technical Change and Wage Inequality", *The Quarterly Journal of Economics*, Vol. 113/4, pp. 1055-1089, https://doi.org/10.1162/003355398555838. [169]

Aghion, P., J. Boulanger and E. Cohen (2011), "Rethinking industrial policy", *Policy Briefs 566*, Bruegel, https://www.bruegel.org/policy-brief/rethinking-industrial-policy. [183]

Aghion, P. et al. (2022), "Industrial Policy and Competition", in *World Scientific Studies in International Economics, Globalization, Firms, and Workers*, WORLD SCIENTIFIC, https://doi.org/10.1142/9789811239472_0015. [45]

Aiginger, K. (2014), "Industrial policy for a sustainable growth path", in Bailey, D., K. Cowling and P. Tomlinson (eds.), *New perspectives on industrial policy*, Oxford University Press, Oxford, https://www.oecd.org/economy/Industrial-Policy-for-a-sustainable-growth-path.pdf. [40]

Aiginger, K. (2007), "Industrial Policy: A Dying Breed or A Re-emerging Phoenix", *Journal of Industry, Competition and Trade*, Vol. 7/3-4, pp. 297-323, https://doi.org/10.1007/s10842-007-0025-7. [142]

Aiginger, K. and D. Rodrik (2020), "Rebirth of Industrial Policy and an Agenda for the Twenty-First Century", *Journal of Industry, Competition and Trade*, Vol. 20, pp. 189-207, https://doi.org/10.1007/s10842-019-00322-3. [10]

Alfaro, L. and D. Chor (2023), "Global Supply Chains: The Looming "Great Reallocation"", *NBER Working Papers*, No. 31661, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w31661. [181]

Amiti, M., S. Redding and D. Weinstein (2019), "The Impact of the 2018 Tariffs on Prices and Welfare", *Journal of Economic Perspectives*, Vol. 33/4, pp. 187-210, https://doi.org/10.1257/jep.33.4.187. [33]

Anderson, B. et al. (2021), "Policies for a climate-neutral industry: Lessons from the Netherlands", *OECD Science, Technology and Industry Policy Papers*, No. 108, OECD Publishing, Paris, https://doi.org/10.1787/a3a1f953-en. [69]

Antràs, P. (2020), "De-Globalisation? Global Value Chains in the Post-COVID-19 Age", *NBER Working Papers*, No. 28115, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w28115. [13]

Appelt, S. et al. (2016), "R&D Tax Incentives: Evidence on design, incidence and impacts", *OECD Science, Technology and Industry Policy Papers*, No. 32, OECD Publishing, Paris, https://doi.org/10.1787/5jlr8fldqk7j-en. [32]

Arias, P. et al. (eds.) (2023), *IPCC, 2023: Climate Change 2023: Synthesis Report, Summary for Policymakers. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]*, IPCC, Geneva, Switzerland., https://doi.org/10.59327/ipcc/ar6-9789291691647.001. [67]

Arriola, C. et al. (2020), "Efficiency and risks in global value chains in the context of COVID-19", *OECD Economics Department Working Papers*, No. 1637, OECD Publishing, Paris, https://doi.org/10.1787/3e4b7ecf-en. [58]

Atalay, E. et al. (2023), "Micro- and Macroeconomic Impacts of a Place-Based Industrial Policy", *NBER Working Papers*, No. 31293, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w31293. [62]

Athey, S. and G. Imbens (2017), "The State of Applied Econometrics: Causality and Policy Evaluation", *Journal of Economic Perspectives*, Vol. 31/2, pp. 3-32, https://doi.org/10.1257/jep.31.2.3. [165]

Atkinson, R., L. Cohen and R. Noll (1992), "The Technology Pork Barrel", *Journal of Policy Analysis and Management*, Vol. 11/4, p. 723, https://doi.org/10.2307/3324970. [97]

Attinasi, M., L. Boeckelmann and B. Meunier (2023), "Unfriendly friends: Trade and relocation effects of the US Inflation Reduction Act", *CEPR VoxEU Column*, 3 Jul 2023, https://cepr.org/voxeu/columns/unfriendly-friends-trade-and-relocation-effects-us-inflation-reduction-act. [146]

Attrey, A., M. Lesher and C. Lomax (2020), "The role of sandboxes in promoting flexibility and innovation in the digital age", *OECD Going Digital Toolkit Notes*, No. 2, OECD Publishing, Paris, https://doi.org/10.1787/cdf5ed45-en. [178]

Aulie, F. et al. (2023), "Did COVID-19 accelerate the green transition?: An international assessment of fiscal spending measures to support low-carbon technologies", *OECD Science, Technology and Industry Policy Papers*, No. 151, OECD Publishing, Paris, https://doi.org/10.1787/5b486c18-en. [15]

Bakhshi, H., A. Freeman and J. Potts (2011), "State of Uncertainty: Innovation policy through experimentation", *Nesta* April, https://www.academia.edu/65938356/State_of_Uncertainty_Innovation_policy_through_experimentation. [99]

Baldwin, R. (2000), "Trade and Growth: Still Disagreement about the Relationships", *OECD Economics Department Working Papers*, No. 264, OECD Publishing, Paris, https://doi.org/10.1787/768732688342. [141]

Bartik, T. (2020), "Using Place-Based Jobs Policies to Help Distressed Communities", *Journal of Economic Perspectives*, Vol. 34/3, pp. 99-127, https://doi.org/10.1257/jep.34.3.99. [91]

Barwick, P., M. Kalouptsidi and N. Zahur (2019), "China's Industrial Policy: an Empirical Evaluation", *NBER Working Papers*, No. 26075, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w26075. [131]

Becker, S., P. Egger and M. von Ehrlich (2018), "Effects of EU Regional Policy: 1989-2013", *Regional Science and Urban Economics*, Vol. 69, pp. 143-152, https://doi.org/10.1016/j.regsciurbeco.2017.12.001. [155]

Becker, S., P. Egger and M. von Ehrlich (2013), "Absorptive Capacity and the Growth and Investment Effects of Regional Transfers: A Regression Discontinuity Design with Heterogeneous Treatment Effects", *American Economic Journal: Economic Policy*, Vol. 5/4, pp. 29-77, https://doi.org/10.1257/pol.5.4.29. [154]

Becker, S., P. Egger and M. von Ehrlich (2010), "Going NUTS: The effect of EU Structural Funds on regional performance", *Journal of Public Economics*, Vol. 94/9-10, pp. 578-590, https://doi.org/10.1016/j.jpubeco.2010.06.006. [153]

Bernini, C. and G. Pellegrini (2011), "How are growth and productivity in private firms affected by public subsidy? Evidence from a regional policy", *Regional Science and Urban Economics*, Vol. 41/3, pp. 253-265, https://doi.org/10.1016/j.regsciurbeco.2011.01.005. [88]

Bistline, J. et al. (2023), "Emissions and energy impacts of the Inflation Reduction Act", *Science*, Vol. 380/6652, pp. 1324-1327, https://doi.org/10.1126/science.adg3781. [175]

Bistline, J., N. Mehrotra and C. Wolfram (2023), "Economic Implications of the Climate Provisions of the Inflation Reduction Act", *NBER Working Papers*, No. 31267, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w31267. [46]

Blackburne, A. (2022), "China's increasingly cheap wind turbines could open new markets", *S&P Global Market Intelligence, September 26th 2022*, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/china-s-increasingly-cheap-wind-turbines-could-open-new-markets-72152297. [63]

Blonigen, B. (2015), "Industrial Policy and Downstream Export Performance", *The Economic Journal*, Vol. 126/595, pp. 1635-1659, https://doi.org/10.1111/ecoj.12223. [156]

BloombergNEF (2023), *IRA Support for Solar Modules Exactly Matches China Price*. [163]

Bolt, W., K. Mavromatis and S. van Wijnbergen (2019), "The Global Macroeconomics of a Trade War. The Eagle Model on the US-China Trade Conflict", *SSRN Electronic Journal*, https://doi.org/10.2139/ssrn.3328570. [176]

Boushey, H. (2023), *The Economics of Public Investment Crowding in Private Investment*, The White House Blog, https://www.whitehouse.gov/briefing-room/blog/2023/08/16/the-economics-of-public-investment-crowding-in-private-investment/. [74]

Bown, C. (2023), "How the United States solved South Korea's problems with electric vehicle subsidies under the Inflation Reduction Act", *Peterson Institute for International Economics Working Paper*, No. 23-6, https://www.piie.com/publications/working-papers/how-united-states-solved-south-koreas-problems-electric-vehicle. [126]

Bown, C. (2023), "The Return of Export Controls. A Risky Tactic That Requires Cooperation From Allies", *Foreign Affairs*, 24 Jan 2023, https://www.foreignaffairs.com/united-states/return-export-controls. [186]

Bown, C. and K. Clausing (2023), "How to cooperate when the United States, EU and China have very different climate and trade policies", *Presentation at PIIE's conference on "The macroeconomic implications of climate action"*, https://www.piie.com/sites/default/files/2023-06/2023-06-06-06bown-klausing-ppt.pdf. [54]

Bown, C. and J. Hillman (2019), "WTO'ing a Resolution to the China Subsidy Problem", *Journal of International Economic Law*, Vol. 22/4, pp. 557-578, https://doi.org/10.1093/jiel/jgz035. [101]

Branstetter, L. and G. Li (2022), "Does "Made in China 2025" Work for China? Evidence from Chinese Listed Firms"*, NBER Working Papers*, No. 30676, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w30676. [130]

Branstetter, L., G. Li and M. Ren (2022), "Picking Winners? Government Subsidies and Firm Productivity in China"*, NBER Working Papers*, No. 30699, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w30699. [89]

Cameron, L. and B. van der Zwaan (2015), "Employment factors for wind and solar energy technologies: A literature review", *Renewable and Sustainable Energy Reviews*, Vol. 45, pp. 160-172, https://doi.org/10.1016/j.rser.2015.01.001. [161]

Cammeraat, E., A. Dechezleprêtre and G. Lalanne (2022), "Innovation and industrial policies for green hydrogen"*, OECD Science, Technology and Industry Policy Papers*, No. 125, OECD Publishing, Paris, https://doi.org/10.1787/f0bb5d8c-en. [93]

Causa, O. et al. (2022), "A cost-of-living squeeze? Distributional implications of rising inflation"*, OECD Economics Department Working Papers*, No. 1744, OECD Publishing, Paris, https://doi.org/10.1787/4b7539a3-en. [162]

Cerqua, A. and G. Pellegrini (2020), "Local multipliers at work", *Industrial and Corporate Change*, Vol. 29/4, pp. 959-977, https://doi.org/10.1093/icc/dtaa004. [52]

Cervantes, M. et al. (2023), "Driving low-carbon innovations for climate neutrality"*, OECD Science, Technology and Industry Policy Papers*, No. 143, OECD Publishing, Paris, https://doi.org/10.1787/8e6ae16b-en. [17]

Chimits, F. (2023), "What Do We Know About Chinese Industrial Subsidies?"*, CEPII Policy Brief*, No. 42, CEPII, Paris, http://www.cepii.fr/PDF_PUB/pb/2023/pb2023-42.pdf. [20]

Choi, J. and A. Levchenko (2021), "The Long-Term Effects of Industrial Policy"*, NBER Working Papers*, No. 29263, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w29263. [147]

Clausing, K. and C. Wolfram (2023), "Carbon Border Adjustments, Climate Clubs, and Subsidy Races When Climate Policies Vary", *Journal of Economic Perspectives*, Vol. 37/3, pp. 137-162, https://doi.org/10.1257/jep.37.3.137. [100]

Congressional Budget Office (2022), *Estimated Budgetary Effects of H.R. 4346, as Amended by the Senate and as Posted by the Senate Committee on Commerce, Science, and Transportation on July 20, 2022*, Congressional Budget Office and Joint Committee on Taxation, https://www.cbo. gov/system/files/2022-07/hr4346_chip.pdf. [107]

Congressional Budget Office (2022), *Summary Estimated Budgetary Effects of Public Law 117-169, to Provide for Reconciliation Pursuant to Title II of S. Con. Res. 14*, Congressional Budget Office and Joint Committee on Taxation, https://www.cbo.gov/publication/58455#:~:text=Summary,in%20revenues%20of%20%24108.7%20billion. [109]

Cooper, V. (2022), *Explainer: The CHIPS and Science Act 2022*, https://www.ussc.edu.au/analysis/explainer-the-chips-and-science-act-2022. [106]

Criscuolo, C. et al. (2023), "Quantifying industrial strategies across nine OECD countries", *OECD Science, Technology and Industry Policy Papers*, No. 150, OECD Publishing, Paris, https://doi.org/10.1787/5f2dcc8e-en. [1]

Criscuolo, C. et al. (2022), "An industrial policy framework for OECD countries: Old debates, new perspectives", *OECD Science, Technology and Industry Policy Papers*, No. 127, OECD Publishing, Paris, https://doi.org/10.1787/0002217c-en. [23]

Criscuolo, C. et al. (2022), "Are industrial policy instruments effective?: A review of the evidence in OECD countries", *OECD Science, Technology and Industry Policy Papers*, No. 128, OECD Publishing, Paris, https://doi.org/10.1787/57b3dae2-en. [24]

Criscuolo, C. et al. (2019), "Some Causal Effects of an Industrial Policy", *American Economic Review*, Vol. 109/1, pp. 48-85, https://doi.org/10.1257/aer.20160034. [31]

Crowe, D. and Ł. Rawdanowicz (2023), "Risks and opportunities of reshaping global value chains", *OECD Economics Department Working Papers*, No. 1762, OECD Publishing, Paris, https://doi.org/10.1787/f758afe8-en. [55]

Curtis, E. and I. Marinescu (2022), "Green Energy Jobs in the US: What Are They, and Where Are They?", *NBER Working Papers*, No. 30332, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w30332. [187]

D'Aguanno, L. et al. (2021), *Global value chains, volatility and safe openness: is trade a double-edged sword?*, Bank of England, https://www.bankofengland.co.uk/financial-stability-paper/2021/global-value-chains-volatility-and-safe-openness-is-trade-a-double-edged-sword. [56]

Dahlman, C., S. Mealy and M. Wermelinger (2016), "Harnessing the digital economy for developing countries", *OECD Development Centre Working Papers*, No. 334, OECD Publishing, Paris, https://doi.org/10.1787/4adffb24-en. [164]

Dechezleprêtre, A. et al. (2016), "Do tax Incentives for Research Increase Firm Innovation? An RD Design for R&D", *NBER Working Papers*, No. 22405, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w22405. [150]

Dechezleprêtre, A. et al. (2022), "Fighting Climate Change: International Attitudes Toward Climate Policies", *NBER Working Papers*, No. 30265, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w30265. [188]

DiPippo, G. et al. (2022), *Red Ink: Estimating Chinese Industrial Policy Spending in Comparative Perspective*, Center for Strategic and International Studies, https://www.csis.org/analysis/red-ink-estimating-chinese-industrial-policy-spending-comparative-perspective. [19]

Ehrlich, M. and H. Overman (2020), "Place-based policies and spatial disparities across European Cities", *Journal of Economic Perspectives*, Vol. 34/3, https://doi.org/10.1257/jep.34.3.128. [61]

Ehrlich, M. and T. Seidel (2018), "The persistent effects of place-based policy: Evidence from the West-German Zonenrandgebiet", *American Economic Journal: Economic Policy*, Vol. 10/4, https://doi.org/10.1257/pol.20160395. [49]

Einiö, E. and H. Overman (2016), "The (Displacement) Effects of Spatially Targeted Enterprise Initiatives: Evidence from UK LEGI", *SERC Discussion Paper*, Vol. 191, https://cep.lse.ac.uk/_new/publications/abstract.asp?index=4912. [60]

Eppinger, P. et al. (2021), "Decoupling Global Value Chains", *SSRN Electronic Journal*, https://doi.org/10.2139/ssrn.3848341. [57]

European Commission (2023), "A Green Deal Industrial Plan for the Net-Zero Age", *Communication from the Commission to the European Parliament, the European Council, the European Economic and Social Committee and the Committee of the Regions* COM(2023) 62, https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2023:62:FIN. [82]

European Commission (2023), *Proposal for a regulation of the European Parliament and of the Council establishing a framework for ensuring a secure and sustainable supply of critical raw materials*, European Commission, COM(2023) 160, https://single-market-economy.ec.europa.eu/publications/european-critical-raw-materials-act_en. [117]

European Commission (2023), *Regulation of the European Parliment and of the Council on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act)*, COM(2023) 161 final, European Commission, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0161. [115]

European Commission (2022), *Proposal for a Regulation of the European Parliment and of the Council establishing a framework of measures for strengthening Europe's semiconductor ecosystem (Chips Act)*, COM/2022/46 final, European Union, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52022PC0046. [112]

European Commission (2021), *Strategic Dependencies and Capacities*, Commission Staff Working Document, SWD(2021) 352 final, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021SC0352. [80]

Fajgelbaum, P. et al. (2020), "The Return to Protectionism*", *The Quarterly Journal of Economics*, Vol. 135/1, pp. 1-55, https://doi.org/10.1093/qje/qjz036. [34]

Fay, M., S. Hallegatte and A. Vogt-Schilb (2013), *Green industrial policies : when and how (English)*., http://documents.worldbank.org/curated/en/994641468156896733/Green-industrial-policies-when-and-how. [160]

Finck, D. and P. Tillmann (2023), "The Macroeconomic Effects of Global Supply Chain Disruptions", *SSRN Electronic Journal*, https://doi.org/10.2139/ssrn.4349825. [177]

Findeisen, F. and Y. Wernert (2023), "Meeting the costs of resilience: The EU's Critical Raw Materials Strategy must go the extra kilometer", *Hertie School Jacques Delors Centre Policy Brief*, https://www.delorscentre.eu/en/publications/eu-critical-raw-materials. [118]

Fishlow, A. (1989), "Latin American Failure against the Backdrop of Asian Success", *The ANNALS of the American Academy of Political and Social Science*, Vol. 505/1, https://doi.org/10.1177/0002716289505001010. [140]

Fort, T., J. Pierce and P. Schott (2018), "New Perspectives on the Decline of US Manufacturing Employment", *Journal of Economic Perspectives*, Vol. 32/2, pp. 47-72, https://doi.org/10.1257/jep.32.2.47. [182]

Goldberg, P. and T. Reed (2023), "Is the Global Economy Deglobalizing? And if so, why? And what is next?", *NBER Working Papers*, No. 31115, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w31115. [145]

Government of Canada (2023), "Agreement on joint support for electric vehicle and battery projects will attract economic growth and create thousands of good-paying jobs", *Statement by the governments of Canada and Ontario, July 6 2023*, https://www.canada.ca/en/innovation-science-economic-development/news/2023/07/canada-and-ontario-establish-an-auto-pact-to-secure-stellantis-lges-and-volkswagen-deals.html. [111]

Government of Canada (2023), *Budget 2023: A Made-In-Canada-Plan*, https://www.budget.canada.ca/2023/pdf/budget-2023-en.pdf. [110]

Gradeva, M. and V. Dillies (2022), "France 2030: Une réponse économique aux enjeux de demain", *Les Thémas de la DGE*, Ministère de l'Economie, des Finances et de la Souveraineté Industrielle et Numérique, https://www.entreprises.gouv.fr/files/files/en-pratique/etudes-et-statistiques/themas/themas-dge-n5.pdf. [173]

Green, A. (2019), "What is happening to middle skill workers?", *OECD Social, Employment and Migration Working Papers*, No. 230, OECD Publishing, Paris, https://doi.org/10.1787/a934f8fa-en. [85]

Greenstone, M. and E. Moretti (2003), "Bidding for Industrial Plants: Does Winning a 'Million Dollar Plant' Increase Welfare?", *NBER Working Papers*, No. 9844, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w9844. [47]

Greenwald, T. (2013), *Secrets of Darpa's Innovation Machine*, http://www.forbes.com/sites/tedgreenwald/2013/02/15/secrets-of-darpas-innovation-machine/. [189]

Hasanov, F. and R. Cherif (2019), "The Return of the Policy That Shall Not Be Named: Principles of Industrial Policy", *IMF Working Papers*, Vol. 2019/074, https://doi.org/10.5089/9781498305402.001. [143]

Heath, J. (2020), "The new national security challenge to the economic order", *Yale Law Journal*, Vol. 129/4, https://www.yalelawjournal.org/pdf/HeathArticle_jx8mdn4b.pdf. [78]

Hourihan, M., M. Muro and M. Roberts Chapman (2023), *The bold vision of the CHIPS and Science Act isn't getting the funding it needs*, https://www.brookings.edu/articles/the-bold-vision-of-the-chips-and-science-act-isnt-getting-the-funding-it-needs/. [190]

Howell, S. (2017), "Financing Innovation: Evidence from R&D Grants", *American Economic Review*, Vol. 107/4, pp. 1136-1164, https://doi.org/10.1257/aer.20150808. [151]

Hufbauer, G. and E. Jung (2021), *Scoring 50 Years of US Industrial Policy, 1970–2020*, Peterson Institute for International Economics, https://www.piie.com/publications/piie-briefings/scoring-50-years-us-industrial-policy-1970-2020. [90]

IEA (2023), *Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach*, International Energy Agency, Paris, https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach. [71]

IEA (2022), *Special Report on Solar PV Global Supply Chains*, OECD Publishing, Paris, https://doi.org/10.1787/9e8b0121-en. [30]

IEA (2021), *Net Zero by 2050: A Roadmap for the Global Energy Sector*, OECD Publishing, Paris, https://doi.org/10.1787/c8328405-en. [73]

IISS (2023), "The United Kingdom's policy on strategic industries", *Strategic Comments*, Vol. 29/3, pp. vii-x, https://doi.org/10.1080/13567888.2023.2219579. [121]

IMF/OECD/World Bank (2022), "Subsidies, Trade, and International Cooperation", *Analytical Notes*, Vol. 2022/001, p. 1, https://doi.org/10.5089/9798400208355.064. [39]

IRENA-GWEC (2013), *30 Years of Policies for Wind Energy: Lessons from 12 Wind Energy Markets*, The International Renewable Energy Agency, Global Wind Energy Council, https://www.irena.org/publications/2013/Jan/30-Years-of-Policies-for-Wind-Energy-Lessons-from-12-Wind-Energy-Markets. [28]

Irwin, D. (2020), "The Rise and Fall of Import Substitution", *NBER Working Papers*, No. 27919, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w27919. [144]

Johnstone, P. et al. (2021), "Exploring the re-emergence of industrial policy: Perceptions regarding low-carbon energy transitions in Germany, the United Kingdom and Denmark", *Energy Research & Social Science*, Vol. 74, p. 101889, https://doi.org/10.1016/j.erss.2020.101889. [11]

Juhász, R. et al. (2022), "The Who, What, When, and How of Industrial Policy: A Text-Based Approach", *SSRN Electronic Journal*, https://doi.org/10.2139/ssrn.4198209. [22]

Juhász, R., N. Lane and D. Rodrik (2023), "The New Economics of Industrial Policy", *NBER Working Papers*, No. 31538, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w31538. [4]

Karp, L. and M. Stevenson (2012), "Green Industrial Policy - Trade and Theory", *CUDARE Working Papers*, No. 123637, https://doi.org/10.22004/ag.econ.123637. [42]

Kaufman, N., S. Saha and C. Bataille (2023), "Green industrial policy will drive decarbonization, but at what cost to trade?", *Finance and Development*, Vol. 60/2, https://www.imf.org/en/Publications/fandd/issues/2023/06/green-trade-tensions-kaufman-saha-bataille. [72]

Kim, J. (2021), "Local Multipliers in New Firm Creation: Inter-Sectoral Spillovers of Entrepreneurship and Startup Agglomeration", *Global Economic Review*, Vol. 50/3, pp. 213-234, https://doi.org/10.1080/1226508x.2021.1874465. [50]

Kleimann, D. et al. (2023), "How Europe should answer the US Inflation Reduction Act", *Policy Contribution*, Vol. 4/23, https://www.bruegel.org/sites/default/files/2023-02/PB%2004%202023_0_1.pdf. [94]

Koh, S., C. MacLeod and E. Rusticelli (2023), "Shifting sands: Trade partner patterns since 2018", *OECD ECOSCOPE Blog*, 12 Jul 2023, https://oecdecoscope.blog/2023/07/12/shifting-sands-trade-partner-patterns-since-2018/. [191]

Koyu, I. et al. (2022), "Japan's Economic Security Promotion Act: Background and Overview", *Asia-Pacific Review*, Vol. 29/3, pp. 28-55, https://doi.org/10.1080/13439006.2022.2154520. [123]

Lane, N. (2022), "Manufacturing Revolutions: Industrial Policy and Industrialization in South Korea", *University of Oxford manuscript, November*, http://hdl.handle.net/10419/263135. [138]

Lane, N. (2020), "The New Empirics of Industrial Policy", *Journal of Industry, Competition and Trade*, Vol. 20/2, pp. 209-234, https://doi.org/10.1007/s10842-019-00323-2. [148]

Lardy, N. (2019), *The state strikes back: The end of economic reform in China?*, Peterson Institute for International Economics, https://www.piie.com/bookstore/state-strikes-back-end-economic-reform-china. [133]

Lind, M. (2019), "The return of geo-economics", *National Interest*, Vol. 2019/164, https://nationalinterest.org/feature/return-geoeconomics-87826. [16]

Mazzucato, M. and D. Rodrik (2023), "Industrial Policy with Conditionalities: A Taxonomy and Sample Cases", No. 2023/07, UCLInstitute for Innovation and Public Purpose,, https://www.ucl.ac.uk/bartlett/publicpurpose/wp2023-07. [95]

Meckling, J. (2021), "Making industrial policy work for decarbonization", *Global Environmental Politics*, Vol. 21/4, https://doi.org/10.1162/glep_a_00624. [43]

Meckling, J. and B. Allan (2020), "The evolution of ideas in global climate policy", *Nature Climate Change*, Vol. 10/5, pp. 434-438, https://doi.org/10.1038/s41558-020-0739-7. [159]

Mitrunen, M. (2021), "War reparations, structural change, and intergenerational mobility", *Manuscript, University of Helsinki*, https://www.sv.uio.no/econ/english/research/news-and-events/events/guest-lectures-seminars/department-seminar/paper/2019/2019-01-14_mitrunen.pdf. [139]

Mohl, P. and T. Hagen (2010), "Do EU structural funds promote regional growth? New evidence from various panel data approaches", *Regional Science and Urban Economics*, Vol. 40/5, pp. 353-365, https://doi.org/10.1016/j.regsciurbeco.2010.03.005. [152]

Moretti, D., D. Boucher and F. Giannini (2021), "Managing fiscal risks: Lessons from case studies of selected OECD countries", *OECD Journal on Budgeting*, https://doi.org/10.1787/7db1d712-en. [53]

Moretti, E. (2010), "Local multipliers", *American Economic Review*, Vol. 100/2, pp. 373-77, https://doi.org/10.1257/aer.100.2.373. [51]

Muro, M. (2023), *Biden's big bet on place-based industrial policy*, Brookings Institution, https://www.brookings.edu/articles/bidens-big-bet-on-place-based-industrial-policy/. [87]

Muro, M. et al. (2022), *Breaking down an $80 billion surge in place-based industrial policy*, Brookings Insititution, https://www.brookings.edu/articles/breaking-down-an-80-billion-surge-in-place-based-industrial-policy/. [86]

Murphy, K. and R. Topel (2013), "Some basic economics of national security", *American Economic Review*, Vol. 103/3, pp. 508-11, https://doi.org/10.1257/aer.103.3.508. [77]

Naughton, B. (2021), *The Rise of China's Industrial Policy, 1978 to 2020*, https://ucigcc.org/publication/the-rise-of-chinas-industrial-policy-1978-to-2020/. [129]

OECD (2024), *OECD Economic Surveys: Japan 2024*, OECD Publishing, Paris, https://doi.org/10.1787/41e807f9-en. [124]

OECD (2023), *Economic Policy Reforms 2023: Going for Growth*, OECD Publishing, Paris, https://doi.org/10.1787/9953de23-en. [92]

OECD (2023), "Government support in industrial sectors: A synthesis report", *OECD Trade Policy Papers*, No. 270, OECD Publishing, Paris, https://doi.org/10.1787/1d28d299-en. [3]

OECD (2023), "Green public procurement strategies", in *Government at a Glance 2023*, OECD Publishing, Paris, https://doi.org/10.1787/72447f84-en. [179]

OECD (2023), "Measuring distortions in international markets: Below-market energy inputs", *OECD Trade Policy Papers*, No. 268, OECD Publishing, Paris, https://doi.org/10.1787/b26140ff-en. [158]

OECD (2023), *OECD Economic Surveys: European Union and Euro Area 2023*, OECD Publishing, Paris, https://doi.org/10.1787/7ebe8cc3-en. [41]

OECD (2023), *OECD Inventory of Support Measures for Fossil Fuels: Country Notes*, OECD Publishing, Paris, https://doi.org/10.1787/5a3efe65-en. [104]

OECD (2023), *OECD Science, Technology and Innovation Outlook 2023: Enabling Transitions in Times of Disruption*, OECD Publishing, Paris, https://doi.org/10.1787/0b55736e-en. [114]

OECD (2023), *Pro-competitive Policies for a Sustainable Economy: Discussion Paper*, http://www.oecd.org/daf/competition/pro-competitive-policies-for-a-sustainable-economy-discussion-paper.pdf. [76]

OECD (2023), "Science, technology and innovation policy in times of global crises", in *OECD Science, Technology and Innovation Outlook 2023: Enabling Transitions in Times of Disruption*, OECD Publishing, Paris, https://doi.org/10.1787/d54e7884-en. [27]

OECD (2023), "The Impact of R&D tax incentives: Results from the OECD microBeRD+ project", *OECD Science, Technology and Industry Policy Papers*, No. 159, OECD Publishing, Paris, https://doi.org/10.1787/1937ac6b-en. [25]

OECD (2022), *Agricultural Policy Monitoring and Evaluation 2022: Reforming Agricultural Policies for Climate Change Mitigation*, OECD Publishing, Paris, https://doi.org/10.1787/7f4542bf-en. [102]

OECD (2022), *Climate Tipping Points: Insights for Effective Policy Action*, OECD Publishing, Paris, https://doi.org/10.1787/abc5a69e-en. [66]

OECD (2022), *OECD Economic Surveys: China 2022*, OECD Publishing, Paris, https://doi.org/10.1787/b0e499cf-en. [135]

OECD (2022), *OECD Economic Surveys: United Kingdom 2022*, OECD Publishing, Paris, https://doi.org/10.1787/7c0f1268-en. [120]

OECD (2022), *OECD Review of Fisheries 2022*, OECD Publishing, Paris, https://doi.org/10.1787/9c3ad238-en. [103]

OECD (2021), *Effective Carbon Rates 2021: Pricing Carbon Emissions through Taxes and Emissions Trading*, OECD Series on Carbon Pricing and Energy Taxation, OECD Publishing, Paris, https://doi.org/10.1787/0e8e24f5-en. [68]

OECD (2021), *Managing Climate Risks, Facing up to Losses and Damages*, OECD Publishing, Paris, https://doi.org/10.1787/55ea1cc9-en. [65]

OECD (2021), "Measuring distortions in international markets: Below-market finance", *OECD Trade Policy Papers*, No. 247, OECD Publishing, Paris, https://doi.org/10.1787/a1a5aa8a-en. [132]

OECD (2021), *OECD Companion to the Inventory of Support Measures for Fossil Fuels 2021*, OECD Publishing, Paris, https://doi.org/10.1787/e670c620-en. [137]

OECD (2021), *Policies for a Carbon-Neutral Industry in the Netherlands*, OECD Publishing, Paris, https://doi.org/10.1787/6813bf38-en. [172]

OECD (2020), *OECD Review of Fisheries 2020*, OECD Publishing, Paris, https://doi.org/10.1787/7946bc8a-en. [136]

OECD (2020), *The role of competition policy in promoting economic recovery*, http://www.oecd.org/daf/competition/the-role-of-competition-policy-in-promoting-economicrecovery-2020.pdf. [44]

OECD (2019), *Local Content Requirements*, OECD Publishing, Paris, https://issuu.com/oecd.publishing/docs/local_content_requirements. [37]

OECD (2019), "Measuring distortions in international markets: The aluminium value chain", *OECD Trade Policy Papers*, No. 218, OECD Publishing, Paris, https://doi.org/10.1787/c82911ab-en. [157]

OECD (2019), "Measuring distortions in international markets: The semiconductor value chain", *OECD Trade Policy Papers*, No. 234, OECD Publishing, Paris, https://doi.org/10.1787/8fe4491d-en. [134]

OECD (2016), *Green Investment Banks: Scaling up Private Investment in Low-carbon, Climate-resilient Infrastructure*, Green Finance and Investment, OECD Publishing, Paris, https://doi.org/10.1787/9789264245129-en. [98]

OECD (2015), "Local-content requirements in the solar- and wind-energy global value chains", in *Overcoming Barriers to International Investment in Clean Energy*, OECD Publishing, Paris, https://doi.org/10.1787/9789264227064-6-en. [75]

OECD (2015), *The Future of Productivity*, OECD Publishing, Paris, https://doi.org/10.1787/9789264248533-en. [26]

OECD (forthcoming), *Mission-oriented innovation policy for net-zero*, OECD Publishing, Paris. [174]

OECD (forthcoming), *OECD Economic Surveys: France 2024*, OECD Publishing, Paris. [119]

Okazaki, T. (2000), "Government-Firm Relationship in Postwar Japan: Success and failure of the bureau-pluralism", *Discussion Paper CIRJE-F-69* April, https://www.cirje.e.u-tokyo.ac.jp/research/dp/2000/2000cf69.pdf. [184]

O'Sullivan, E. et al. (2013), "What is new in the new industrial policy? A manufacturing systems perspective", *Oxford Review of Economic Policy*, Vol. 29/2, https://doi.org/10.1093/oxrep/grt027. [7]

Oxford Economics (2021), "The US-China Economic Relationship: A crucial partnership at a critical juncture", *The US-China Business Council*, Vol. January, https://www.oxfordeconomics.com/resource/the-us-china-economic-relationship-a-crucial-partnership-at-a-critical-juncture/. [35]

Ragonnaud, G. (2022), *The EU chips act: Securing Europe's supply of semiconductors*, European Parliamentary Research Service, https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2022)733596. [113]

Rawdanowicz, Ł. et al. (2021), "Constraints and demands on public finances: Considerations of resilient fiscal policy", *OECD Economics Department Working Papers*, No. 1694, OECD Publishing, Paris, https://doi.org/10.1787/602500be-en. [105]

Roberts, D. (2021), *Xi Jinping's Politics in Command Economy*, Atlantic Council Scowcroft Center for Strategy and Security, https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/issue-brief-xi-jinpings-politics-in-command-economy/. [127]

Rodrik, D. (2021), "Why Does Globalization Fuel Populism? Economics, Culture, and the Rise of Right-Wing Populism", *Annual Review of Economics*, Vol. 13/1, pp. 133-170, https://doi.org/10.1146/annurev-economics-070220-032416. [14]

Rodrik, D. (2014), "Green industrial policy", *Oxford Review of Economic Policy*, Vol. 30/3, https://doi.org/10.1093/oxrep/gru025. [29]

Rodrik, D. (2009), "Industrial Policy: Don't Ask Why, Ask How", *Middle East Development Journal*, Vol. 1/1, https://doi.org/10.1142/s1793812009000024. [167]

Rodrik, D. (1998), "Has Globalization Gone Too Far?", *Challenge*, Vol. 41/2, pp. 81-94, http://www.jstor.org/stable/40721822. [12]

Romer, P. (1993), "Implementing a National Technology Strategy with Self-Organizing Industry Investment Boards", *Brookings Papers on Economic Activity. Microeconomics*, Vol. 1993/2, p. 345, https://doi.org/10.2307/2534742. [170]

Salazar-Xirinachs, J., I. Nübler and R. Kozul-Wright (2014), *Transforming economies. Making industrial policy work for growth, jobs and development*, International Labour Organization, https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms_315664.pdf. [5]

Sandkamp, A. (2022), "Reshoring by Decree? The Effects of Decoupling Europe from Global Value Chains", *Intereconomics*, Vol. 57/6, pp. 359-362, https://doi.org/10.1007/s10272-022-1087-9. [59]

SCCEI and CCA (2023), *China's Industrial Policy. Roundtable Summary Report*, The Stanford Center on China's Economy and Institutions (SCCEI) and Asia Society Policy Institute's Center for China Analysis (CCA), https://asiasociety.org/sites/default/files/2023-01/ASPI_SCCEI_China%20Industrial%20Policy_%20Roundtable%20%20Summary%20Report_Final.pdf. [21]

Schwartz, M. (1986), "The nature and scope of contestability theory", *Oxford Economic Papers*, Vol. 38/SUPP, https://doi.org/10.1093/oxfordjournals.oep.a041766. [171]

Schwellnus, C. et al. (2023), "Global value chain dependencies under the magnifying glass", *OECD Science, Technology and Industry Policy Papers*, No. 142, OECD Publishing, Paris, https://doi.org/10.1787/b2489065-en. [79]

SIA (2023), *Chipping Away: Assessing and Addressing the Labor Market Gap Facing the U.S. Semiconductor Industry*, Semiconductor Industry Association, https://www.semiconductors.org/chipping-away-assessing-and-addressing-the-labor-market-gap-facing-the-u-s-semiconductor-industry/. [192]

Sorbe, S., P. Gal and V. Millot (2018), "Can productivity still grow in service-based economies?: Literature overview and preliminary evidence from OECD countries", *OECD Economics Department Working Papers*, No. 1531, OECD Publishing, Paris, https://doi.org/10.1787/4458ec7b-en. [84]

Stiglitz, J., J. Lin and C. Monga (2013), *The rejuvenation of industrial policy*, World Bank Group, https://doi.org/10.1596/1813-9450-6628. [8]

Stone, S., J. Messent and D. Flaig (2015), "Emerging Policy Issues: Localisation Barriers to Trade", *OECD Trade Policy Papers*, No. 180, OECD Publishing, Paris, https://doi.org/10.1787/5js1m6v5qd5j-en. [36]

Sykes, A. (2005), "The Economics of WTO Rules on Subsidies and Countervailing Measures", *SSRN Electronic Journal*, https://doi.org/10.2139/ssrn.415780. [38]

Szczepański, M. (2021), *Resilience of global supply chains: Challenges and solutions*, European Parliamentary Research Service, https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)698815. [125]

Tagliapietra, S., R. Veugelers and J. Zettelmeyer (2023), "Rebooting the European Union's Net Zero Industry Act", *Bruegel Policy Brief*, https://www.bruegel.org/policy-brief/rebooting-european-unions-net-zero-industry-act. [116]

Tagliapietra, S. and R. Veugelers (2020), *A green industrial policy for Europe*, https://www.bruegel.org/book/green-industrial-policy-europe. [149]

Terzi, A., A. Singh and M. Sherwood (2022), "Industrial Policy for the 21st Century Lessons from the Past", *European Economy - Discussion Papers*, No. 157, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission, https://economy-finance.ec.europa.eu/publications/industrial-policy-21st-century-lessons-past_en. [2]

The White House (2023), *Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action*, https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf. [108]

The White House (2022), *Executive Order on America's Supply Chains: A Year of Action and Progress*, https://www.whitehouse.gov/wp-content/uploads/2022/02/Capstone-Report-Biden.pdf. [81]

The White House (2022), "Remarks on Executing a Modern American Industrial Strategy by NEC Director Brian Deese, October 13 2022", https://www.whitehouse.gov/briefing-room/speeches-remarks/2022/10/13/remarks-on-executing-a-modern-american-industrial-strategy-by-nec-director-brian-deese/. [83]

Thirlwell, M. (2010), *The Return of Geo-economics: Globalisation and National Security*, Lowy Institute for International Policy, https://www.files.ethz.ch/isn/121234/Thirlwell,%20The%20return%20of%20geo-economics_web%20and%20print.pdf. [185]

Tirole, J. (2019), *Economics for the Common Good*, https://doi.org/10.2307/j.ctvc77hng. [96]

US Department of Energy (2015), "The Department of Energy's Loan Guarantee to Solyndra, Inc.", *Special Report 11-0078-I*, https://www.energy.gov/sites/default/files/2015/08/f26/11-0078-I.pdf. [64]

van Dijk, J. (2016), "Local employment multipliers in U.S. cities", *Journal of Economic Geography*, p. lbw010, https://doi.org/10.1093/jeg/lbw010. [48]

Wade, R. (2012), "Return of industrial policy?", *International Review of Applied Economics*, Vol. 26/2, https://doi.org/10.1080/02692171.2011.640312. [6]

Warwick, K. (2013), "Beyond Industrial Policy: Emerging Issues and New Trends", *OECD Science, Technology and Industry Policy Papers*, No. 2, OECD Publishing, Paris, https://doi.org/10.1787/5k4869clw0xp-en. [9]

Warwick, K. and A. Nolan (2014), "Evaluation of Industrial Policy: Methodological Issues and Policy Lessons", *OECD Science, Technology and Industry Policy Papers*, No. 16, OECD Publishing, Paris, https://doi.org/10.1787/5jz181jh0j5k-en. [18]

Way, R. et al. (2022), "Empirically grounded technology forecasts and the energy transition", *Joule*, Vol. 6/9, pp. 2057-2082, https://doi.org/10.1016/j.joule.2022.08.009. [70]

Wu, Y., X. Zhu and N. Groenewold (2019), "The determinants and effectiveness of industrial policy in china: A study based on Five-Year Plans", *China Economic Review*, Vol. 53, https://doi.org/10.1016/j.chieco.2018.09.010. [128]

Zhang, H. (2021), "The Impact of COVID-19 on Global Production: Evidence from Japanese Multinational Firms", *The International Economy*, Vol. 24/0, pp. 142-165, https://doi.org/10.5652/internationaleconomy/ie2020.24.06.hz. [122]

Annex A. Recent industrial policy initiatives in selected countries

United States

1. US authorities have been concerned about the resilience of supply chains for manufactured goods that are critical inputs for the economy due to a high concentration of production in China, and about the much-needed acceleration in preventing climate change. These concerns have led the US government in 2022 to embark on a big-scale public support to domestic production and the green transition. Several of these initiatives have significant place-based industrial policy characteristics (Muro et al., 2022[86]; Muro, 2023[87]).

The CHIPS and Science Act[1]

2. The act aims at strengthening US competitiveness, innovation, national security in the semiconductor sector and increasing a science, technology, engineering and math (STEM) workforce. The main measures involve tax credits for investment in manufacturing, sectoral research and development (R&D) funding, and funding for education and skills (Cooper, 2022[106]). The act appropriated around USD 53 billion (0.2% of GDP) over five years for these objectives, including around USD 39 billion of incentives for building semiconductor plants and around USD 13 billion for supporting R&D and workforce in this area. It provided a 25% tax credit for building and equipping the plants initiated before 2027. The credit is estimated to cost USD 24.3 billion over ten years (Congressional Budget Office, 2022[107]). It also significantly increased authorised spending for federal science and technology R&D programmes, administered by multiple federal agencies (amounting to around USD 174 billion through fiscal year 2027, equivalent to 0.7% of 2022 GDP).

3. The CHIPS and Science Act also involves measures to hinder the expansion of semiconductor manufacturing in China or any other countries that pose a threat to US national security. With limited exceptions, it prohibits recipients of its funding and investment tax credits from expanding semiconductor manufacturing in countries posing national security threat for ten years. The act also includes several provisions related to research security.

The Inflation Reduction Act (IRA)

4. The act attempts to comprehensively reshape the US power sector by supporting the decarbonisation of electricity generation and electric vehicles industries with several measures (The White House, 2023[108]; Bistline, Mehrotra and Wolfram, 2023[46]).

- The main measures are production and investment tax credits for clean electricity and energy storage. Production tax credit is awarded per megawatt-hour of produced electricity from low-emitting resources, while investment tax credit is proportional to investment costs. The incentive is five times higher for projects that satisfy specific wage and apprenticeship criteria. In addition, the tax credits are higher for projects that use specific domestically produced materials (including steel), conditional on fulfilling the labour requirements, and are located in the so-called

[1] CHIPS stands for Creating Helpful Incentives to Produce Semiconductors.

energy communities (that have brownfield sites, or have high employment and tax revenue from fossil fuels, or experience a closure of a coal mine or a plant). The production and investment tax credits will phase down at the earliest in 2032, but the date could be postponed until the power sector emissions reach 25% of their 2022 level.

- The IRA also provides tax credits up to USD 7.5 thousand for the purchase of a new electric or hydrogen vehicle conditional on meeting several conditions. The latter include some local content requirements, stipulating that the final assembly must be done in North America, a share of the critical minerals and the battery components must come from North America (or a country with which the United States have a free-trade agreement in case of critical minerals).[2] Some clean vehicles tax incentives involve price and taxpayers' income limits.
- Tax credits are granted also for carbon capture and sequestration, nuclear power production, to individual taxpayers when investing in energy efficiency improvements of their homes, clean transportation and industrial fuels, and clean energy manufacturing facilities.

5. The IRA tax credits can become effectively grants for non-profit organisations and state and local governments who do not pay taxes (the so-called direct pay). They can be also transferred to an unrelated party. Consequently, even firms and individuals with no tax liabilities could benefit from tax credits if they receive financial compensation from the third party.

6. Most tax credits are not capped, making valuations of their costing uncertain. The Congressional Budget Office (2022[109]) estimated that all tax credits could amount to USD 271 billion over ten years (1.1% of 2022 GDP). However, several alternative estimates point to much higher costing, partly reflecting effectively longer duration of the financial support than covered in the Congressional Budget Office report (Bistline, Mehrotra and Wolfram, 2023[46]).

Canada

7. In March 2023, Canada outlined a new industrial strategy called "A Made in Canada Plan", with the triple objective to attract new investment, create high-quality jobs and support the clean economy. The plan contains a range of measures relying on three main types of instruments: investment tax credits, low-cost strategic financing and targeted investments. Some of these measures were already in place or had been announced earlier. For instance, this is the case for the Canada Growth Fund, an arm's length agency capitalised with CAD 15 billion (0.5 % of GDP) intended to catalyse private investment in clean technologies through various financing instruments.

8. The plan also includes new measures, partly responding to the US IRA, including the introduction of refundable tax credits for investments in clean electricity, clean technology manufacturing, carbon capture and clean hydrogen production, with an expected cost of CAD 16.4 billion through to 2028 (Government of Canada, 2023[110]).

9. Recently, the government has also implemented measures to support specific electric vehicle and battery projects, explicitly seeking to match the incentives provided by the US IRA. It announced that these financial aids would be revised should the US IRA incentives be reduced or cancelled (Government of Canada, 2023[111]).

[2] The treasury guidance issued in December 2022 waived the battery sourcing requirements, price caps and income eligibility for companies leasing cars to consumers.

European Union

10. The European Commission presented in March 2020 its *New Industrial Strategy for Europe*, aiming to support the green and digital transitions and to reduce strategic dependencies on imports. The strategy was revised in May 2021 to reflect the new context of the EU economy following the COVID-19 crisis. In the course of 2022 and 2023, the European Commission published several legislative proposals related to the New Industrial Strategy, in response to the US IRA and CHIPS and Science Act (see above).

11. The European Chips Act came into force in September 2023 and aims at fostering semiconductor production in the European Union, reducing external dependencies, and doubling the EU's global market share to 20% in 2030. The act is based on a three-pillar structure: the "Chips for Europe" initiative which seeks to support research, development and innovation in the EU chips ecosystem and improve the transition "from lab to fab"; the second pillar focusing on improving supply security with a new framework to attract large-scale investments in production capacities; and the last pillar aiming at setting up a co-ordination mechanism between member states and the Commission to monitor market developments and anticipate crises (European Commission, 2022[112]). The act provides derogations to state aid rules for key facilities, reallocates EUR 3.3 billion (0.02 % of GDP) from existing EU funds to relevant projects, complemented by EUR 2.9 billion, and seeks to rationalise investment by member states. The European Commission intends to mobilise EUR 43 billion (0.3% of GDP) in public and private funds through the act, with EUR 11 billion coming from repurposing existing funds (Ragonnaud, 2022[113]; OECD, 2023[114]). EU subsidies are provided for investment in new, first-of-their kind facilities.

12. In March 2023, the Commission proposed a Net-Zero Industry Act (NZIA) and a Critical Raw Materials (CRM) Act, both part of the EU Green Deal Industrial Plan.[3] The NZIA seeks to scale up the manufacturing in Europe of a range of net-zero strategic technologies, such as solar photovoltaic and solar thermal technologies, onshore and offshore renewable technologies, battery/storage technologies, and carbon capture and storage technologies. The aim is to domestically manufacture 40% of EU needs in these technologies by 2030.

13. The NZIA proposes a range of measures to support selected net-zero strategic projects (NZSP) such as: the acceleration of permits and related administrative procedures, the creation of a platform to facilitate co-ordination of private funding, increased public subsidies, changes in public procurement rules to include sustainability and resilience criteria, and the creation of regulatory sandboxes to support innovation (European Commission, 2023[115]; Tagliapietra, Veugelers and Zettelmeyer, 2023[116]). The proposal does not allocate new EU-level funding, but NZSP should be prioritised in national and EU budgets. Importantly, following revision of the EU State aid rules in March 2023, countries are allowed to provide more support to cleantech production or investment projects. They can also provide matching aid, i.e. the amount of support the beneficiary could receive for an equivalent investment in an alternative location (OECD, 2023[41]).

14. The CRM Act aims at developing a European value chain for selected raw materials identified as key inputs for the green and digital transitions and facing high supply risks. The act proposes several measures to streamline permitting processes and strengthen international engagement, but again without specifically committing any new EU funds (European Commission, 2023[117]; Findeisen and Wernert, 2023[118]).

15. A number of EU countries developed industrial policy initiatives at the national level, for example:

- In October 2023, France adopted a Green Industry Bill, which seeks to reduce carbon emissions while promoting low-carbon industry and reinforcing control on strategic sectors. The bill simplifies administrative procedures and facilitates factory opening, particularly supporting industry in wind

[3] The CRM act has come into force in April 2024 and the NZIA is expected to become effective in June 2024.

power, photovoltaics, heat pumps, batteries and low-carbon hydrogen. It also provides tax credits of up to 40% for investment, and loans or loan guarantees for firms for green investment (OECD, forthcoming[119]).

- In July and August 2023, Germany announced to spend about EUR 20 billion (0.5% of 2022 GDP) to subsidise foreign investments in several semiconductor plants. This is part of a wider plan to boost the semiconductor sector and to attract investment from global leading companies. The government has also set up the Climate and Transformation Fund (KTF), which is supposed to spend about EUR 212 billion (5.5% of GDP) until 2026 on subsidies and public investment to support the green transition. The fund seeks to finance energy-efficient renovation of buildings, the decarbonisation of industry and the expansion of renewable energies, electromobility and charging infrastructure. In October 2023, the government presented a new industrial strategy aiming at maintaining Germany as a strong industrial location, including EUR 50 billion (1.3% of 2022 GDP) of tax incentives for investment over the next four years. However, a Supreme Court ruling in November 2023 implies a reduction of EUR 60 billion in borrowing allowances available for the KTF. This will affect spending plans negatively, especially for 2025 and 2026. While the government has committed to most of the planned spending and tries to raise revenue and cut spending in other areas, the original spending plans may not be fully implemented.
- Italy, building on the Industry 4.0 plan, launched the Transition 4.0 initiative in 2020 and subsequently updated it in 2022. The initiative aims at promoting investment related to the digital and green transitions, through extended tax credits for innovation and design and lower tax rates for capital investments.

United Kingdom

16. In 2021, the government introduced the UK Innovation Strategy to make the United Kingdom a global hub for innovation by 2035. It intends to increase public spending on R&D and improve regulation and support acquiring skills. The strategy identifies seven key technology families where the United Kingdom has globally competitive R&D and where investment should be prioritised. They are advanced materials and manufacturing; artificial intelligence and advanced computing; bioinformatic and genomics; engineering biology; electronics, photonics and quantum; energy and environment technologies; and robotics and smart machines. In 2021, the government also presented a Net Zero Strategy, as a part of the broader Plan for Growth initiative, which seeks to reach net zero emission by 2050, including through supporting the development of low-carbon technologies (OECD, 2022[120]). Moreover, several sectoral strategies were announced between 2021 and 2023, targeting specific sectors or technologies such as artificial intelligence, hydrogen, nuclear fusion, critical minerals and semiconductors (IISS, 2023[121]).

17. In November 2023, the government announced a series of policies aiming at catalysing the growth of strategic manufacturing sectors, with an Advanced Manufacturing Plan, supported by GBP 4.5 billion (0.2% of GDP) of funding over five years from 2025. Over GBP 2 billion (0.09% of GDP) is being made available for the automotive sector to support the manufacturing and development of zero emission vehicles, their batteries and supply chain (as further detailed in the first UK Battery Strategy, also released in November 2023). GBP 975 million (0.04% of GDP) is being made available for the aerospace sector to support the development of energy efficient and zero-carbon aircraft technology. GBP 520 million (0.02% of GDP) is being made available for life sciences to build resilience for future health emergencies. Finally, GBP 960 million is being made available to support investments in manufacturing capabilities for clean energy sectors (namely carbon capture utilisation and storage, hydrogen, offshore wind, electricity networks, and nuclear) through a newly created Green Industries Growth Accelerator (GIGA). The government also announced to issue a Critical Imports and Supply Chains Strategy in December 2023.

Japan

18. Prompted by the COVID-19 crisis, the government of Japan started to introduce a series of measures to reduce the dependence of Japanese supply chains on China. It dedicated part of its April 2020 stimulus package to support companies deciding to move their supply chains back to Japan and to members of the Association of Southeast Asian Nations (ASEAN). It aimed at covering costs for feasibility studies, introducing equipment or constructing new facilities (Zhang, 2021[122]). Later in 2020, it initiated a Programme for Promoting Investment in Japan to Strengthen Supply Chains, with a budget of nearly JPY 612 billion (0.1% of GDP). The programme assists Japanese companies to relocate production back to Japan and Southeast Asian countries. The government also launched a Programme for Strengthening Supply Chains, aiming to assist Japanese companies in diversifying their production lines.

19. In June 2021, the government announced a new "Strategy for Semiconductor and the Digital Industry", seeking to increase domestic development and production of advanced semiconductors as well as other advanced technologies critical for the digital and green transitions. The revised strategy (in June 2023) has a goal to reach more than JPY 15 trillion sales of domestically produced semiconductors by 2030. The strategy relies on tax breaks and subsidies for companies investing in semiconductors, data centres or other critical technologies, but does not provide precise budget costing of these measures. In the context of this strategy, Japan supported the creation of a new chip venture called Rapidus Corp, with public financial support worth JPY 330 billion.

20. In May 2022, the Economic Security Promotion Act was passed to: (i) secure a stable supply of critical products;[4] (ii) ensure the stable provision of critical infrastructure services; (iii) support the development of specified critical technologies; and (iv) maintain confidentiality of patent applications for selected security-related inventions (Koyu et al., 2022[123]).

21. In December 2022, Japan unveiled its Basic Plan for Green Transformation (GX) Policy, relying on a range of instruments including innovation support, green investment, transition finance, regulations, international collaboration and carbon pricing. The government plans to raise JPY 20 trillion (3.6% of GDP) through GX Economy Transition Bonds to kick off private and public investment of around JPY 150 trillion (27% of GDP) over the next ten years, and has outlined a breakdown of investment needs in different areas, such as hydrogen, carbon capture and electric vehicle (EV) adoption (OECD, 2024[124]).

Korea

22. In July 2020, Korea launched its Materials, Parts, Equipment 2.0 Strategy to prepare the economy for shifts in global supply chains after the COVID-19 pandemic. The government committed to spending KRW 1.5 trillion over five years (0.07% of annual GDP) on R&D and offered direct support to firms to cover relocation costs, with additional support provided to firms that relocate outside the Seoul region and those that build smart factories (Szczepański, 2021[125]).

23. In reaction to the US IRA, in early 2023, Korea implemented new measures to support various segments of the electric vehicles supply chains (adjusting its own consumer tax credits for electric vehicles, and supporting investment in technologies and plants), as well as Korean battery makers. They include up to KRW 7 trillion (0.3% of annual GDP) of loans and guarantees offered to help Korean companies seeking to reorient their supply chains away from China to meet the sourcing requirements of the US IRA tax credits, and KRW 20 trillion (0.9% of annual GDP) invested through 2030 to advance new battery technologies (Bown, 2023[126]).

[4] The government then issued in December 2022 a list of 11 critical products eligible for financial aid, including semiconductors, cloud computing, storage batteries, liquefied natural gas, antibacterial substance preparations, fertilisers and permanent magnets (OECD, 2024[124]).

China

24. A combination of state guidance, targets and support and increasing economic freedoms for the private sector have underpinned the Chinese state capitalism economic model (Roberts, 2021[127]; Wu, Zhu and Groenewold, 2019[128]). Five-year plans have traditionally set directions for economic and social policy in China, including specific production and capacity quotas. They have defined which industries, enterprises and products should obtain preferential government support. In some cases, government support was reversed, or even policy measures were used to reduce the production capacity, as distortions became evident.[5] The authorities frequently have focused on output and social objectives, like ensuring sufficient employment, rather than on economic efficiency and profits.

25. The scope and type of industrial policies has changed since the mid-2000s. There has been as a shift in economic orientation from an export-oriented economy based on cheap labour costs to an economy based on technology development, with more control over private companies. Five-year plans have increasingly focused on supporting general purpose technologies and self-sufficiency via top-down industrial plans and state subsidies (Naughton, 2021[129]). In 2006, China announced its first Medium and Long-Term Plan for Science and Technology (Roberts, 2021). It included 16 megaprojects such as development of civilian jetliner, manned spaceflights and nuclear reactors. The next such plan is for 2021-35, though it has not yet been released to the public.

26. "Made in China 2025" was the hallmark of the new industrial strategy (Branstetter and Li, 2022[130]). It is a multi-pronged policy initiative, initiated in 2015, seeking to propel the Chinese economy towards innovation-driven production of higher-value products and services and to become independent from foreign suppliers in these sectors (Branstetter and Li, 2022[130]). The programme targeted ten industries, including next-generation IT, high-end digital control machine tools and robotics, and electric power equipment. The strategy has contributed to a rapid increase in R&D spending and several Chinese technological breakthroughs, including the invention and rollout of Chinese 5G telecommunication networks and developments in artificial intelligence (Cooper, 2022). A complementary programme sought to ensure that new technologies not only boost economic growth but also help military modernisation – the so-called civilian-military fusion (Roberts, 2021).

27. State support have taken various forms (Barwick, Kalouptsidi and Zahur, 2019[131]; OECD, 2021[132]; OECD, 2023[3]). Production subsidies in targeted sectors involved direct financing and tax credits but also cheap inputs thanks to support of upstream industries. The government has also stimulated demand by providing export subsidies and loans to buyers from state-owned banks. Investment support measures have involved low-interest long-term loans, preferential tax measures like accelerated capital depreciation, and subsidised land prices. Targeted sectors and firms have also benefited from regulatory easing thanks to simplified and shortened licencing procedures.

28. A central feature of Chinese industrial policy in the manufacturing sector has been favouring large state-owned enterprises and national champions at the disadvantage of private and small and medium-sized enterprises (Lardy, 2019[133]; Branstetter, Li and Ren, 2022[89]). This was part of the legacy of the prevailing economic model dominated by state-owned firms in the manufacturing sector.

29. Over the past two decades, the Chinese government has taken significant steps to support and develop its semiconductor industry through a set of policies and the establishment of funds aimed at narrowing the technological gap in this sector (OECD, 2019[134]; OECD, 2022[135]). Key milestones in this

[5] Some policy reversal occurred in the case of massive subsidies to the shipbuilding industry in the 2000s. Following the policy-driven massive increase in the sector's output and large gains in the world market share, excess capacity became apparent. Moreover, subsidies attracted inefficient producers, without huge improvements in profitability (Barwick, Kalouptsidi and Zahur, 2019[131]). Consequently, some support measures were phased out after the GFC with a moratorium on entry and a limited "whitelist" of firms picked by government to receive help.

endeavour include the adoption of the National Semiconductor Industry Guidelines in June 2014 and the inclusion of the semiconductor industry in the "Made in China 2025" initiative. The Chinese State Council has also introduced a set of policies to support the high-quality development of the integrated circuit and software industries. They included tax exemptions, especially for producers of small integrated circuits, R&D subsidies, trade facilitation and intellectual property protection. To address funding challenges, the authorities have encouraged the use of government funds, including the China Integrated Circuit Industry Investment Fund and sister funds at provincial and municipal levels (OECD, 2019[134]). They have also promoted the establishment of lending risk compensation mechanisms by local governments and have allowed collateralisation of intellectual property rights (IPRs), shares and receivables to secure loans from commercial banks.

30. In the early 2000s, as part of five-year plans, China supported expanding the domestic production of renewable energy technologies, including by scaling up solar panels and wind turbines manufacturing, with various measures and targets that have evolved over time (IRENA-GWEC, 2013[28]; OECD, 2021[132]; IEA, 2022[30]).

- Initially, solar panel manufacturing has been backed – both at state and provincial levels – by grants, low-cost loans from state banks, funds from the Science and Technology Ministry, and a provision of subsidised land. These measures helped establish several pioneering domestic manufacturers. Subsequently, Chinese authorities identified lacking domestic polysilicon capacity needed to produce solar panels and dependence on imported manufacturing equipment. Consequently, grants, tax incentives, preferential energy prices, and antidumping duty on polysilicon imports from the United States and Korea have been used to increase domestic polysilicon and equipment manufacturing. Since 2009, China has also supported demand via feed-in tariff schemes and the development of new and more efficient technologies via a dedicated Top Runner Programme. As competition in the sector has been high, solar panel producers have become commercially viable and subsidies are being phased out.
- The wind turbine industry in China has been supported by multiple measures. They have included: a mandatory market share of renewable energy in the national electricity supply; competitive bidding, requiring wind turbines to be manufactured with 70% domestically produced content; a requirement for grid operators to purchase a fixed amount of renewable energy; and feed-in tariffs. In addition, the Chinese wind industry has benefited from “cross-subsidies” in sectors like steel, coal and shipbuilding. Steel, crucial for wind projects, accounts for a significant portion of offshore wind turbine material and installation costs, while China’s shipbuilding capabilities allow it to produce vessels essential for offshore wind deployment. The effectiveness of investment has been initially reduced by lack of sufficient grid connections.

Annex B. OECD conceptual frameworks for industrial policy

Conceptual framework for industrial policies

1. The OECD has developed a framework to support analysis of industrial policies (Criscuolo et al., 2022[23]). The proposed framework defines industrial policy as "interventions intended to improve structurally the performance of the domestic business sector". This deliberately broad definition enables to cover a large range of policy instruments. The framework categorises industrial policies according to two main dimensions: (i) the design of industrial strategies, and (ii) the choice of policy instruments. Strategies are viewed as consistent and articulated groups of policy instruments which are designed to reach a given policy objective. Instruments are classified based on their scope (horizontal or targeted) and the channels (e.g. improving firm performance or resource reallocation among firms) via which they operate. By shedding light on complementarities between different policy instruments, this framework offers practical policy advice to help design effective industrial strategies. [1]

2. While these definitions are useful to support empirical and policy discussions, the borders between categories are often blurred. For instance, an R&D tax credit, while horizontal, will often disproportionately benefit research-intensive sectors and regions. On the other hand, policies aimed at supporting small businesses, which are – strictly speaking – targeted, may be considered as part of a horizontal focus on entrepreneurship. Likewise, an investment credit for a particular sector will have impacts on productivity within firms but will also affect a wider allocation of capital and labour in the economy. The scale and specificity of targeting can also vary greatly. For instance, some green subsidy schemes may support all zero-carbon electricity generation, while other programmes may support individual technologies.

Industrial strategies: Different objectives and criteria for selecting targeted measures

3. The framework classifies industrial strategies based on their objective (economic growth, decarbonisation, strategic autonomy, etc.) and their type. Four overarching types of industrial strategies are identified, underpinned by a range of economic and policy rationale for intervention (Table A B.1). In practice, many industrial strategies will seek to simultaneously meet several of these priorities.

- *Sectoral strategies* seek to increase innovation and productivity in a sector or cluster of inter-linked sectors. Economic rationales for such a support relate to the existence of learning-by-doing and economy-of-scale effects, where productivity increases and costs fall with experience and with the rise in production. In some nascent industries, businesses may need support to reach a point of viability and to offset capital market imperfections. Other economic concerns which may merit government intervention include mitigation of informational externalities and co-ordination failures. National security concerns can also motivate intervention if selected sectors or products are perceived as critical for a country's national interest and security.

[1] For instance, it has been used by national administrations (Gradeva and Dillies, 2022[173]), and by the OECD in recent reports on the net-zero transition of the Dutch manufacturing sector (Anderson et al., 2021[69]; OECD, 2021[172]) and the analysis of green hydrogen strategies (Cammeraat, Dechezleprêtre and Lalanne, 2022[93]).

- *Mission-orientated strategies* aim to build packages of innovation, regulatory and supporting measures to tackle specific societal challenges. The rationale for these strategies may be based on the realisation of desired social benefits such as national security, strategic autonomy and climate change mitigation. Failures of co-ordination between industries may prevent such transformative changes to happen if they are left entirely to the private sector. Thus, they can justify policy intervention. Industrial policy can also act as commitment device for governments to signal that they are serious about a regulatory and policy position seeking to bring about a desired change.
- While mission-oriented strategies seek to support innovation towards a specific end, *technology-focused strategies* aim at the broader development and dissemination of new technologies and innovations to boost the performance of the industrial sector. Given the inherent immaturity of new technologies, intervention can be justified here again on the basis of potential for firms to learn by doing and to alleviate informational externalities in technology development or adoption.
- *Place-based strategies* seek to reshape the distribution of industrial activity in a jurisdiction by encouraging the development of industry in particular places, thereby addressing inclusiveness, fairness and/or equality objectives. In addition to equity and political economy concerns, they may also seek to leverage the benefits of clustering and agglomeration by encouraging specialisation of industry in areas where this industry may have a competitive advantage.

4. The wide range of rationales driving the various aims of industrial policies means that there can be significant overlaps between different elements of industrial policy and important interlinkages between industrial policy and other areas such as climate, innovation and trade policy.

Table A B.1. Economic and policy rationales associated with different types of industrial strategies

	Sectoral	Mission-oriented	Technology-focused	Place-based
Learning-by-doing	✓		✓✓	
External economies of scale	✓			
Informational externalities	✓		✓✓	
Competition creation	✓			
Upstream sectors in value chains	✓		✓✓	
Coordination failures	✓	✓✓	✓	
Societal benefits		✓✓		
Acceptability of public investment		✓		
Regulatory uncertainty or Imperfect commitment		✓		
Marshallian externalities				✓

Note: ✓ means relevant; and ✓✓ means especially relevant.
Source: Criscuolo et al. (2022[23]), "An industrial policy framework for OECD countries: Old debates, new perspectives", *OECD Science, Technology and Industry Policy Papers*, No. 127, OECD Publishing, Paris, https://doi.org/10.1787/0002217c-en.

Policy instruments to reach the strategy's objectives

5. The framework provides a taxonomy of industrial policy instruments, built around two analytical concepts:

- The *channels* through which instruments operate. The framework distinguishes: demand-side instruments (such as regulation or public procurement); supply-side instruments seeking to improve either performance within firms (such as investment incentives, training supports or subsidies) or the economy's allocative efficiency for production factors (e.g. framework instruments targeting the functioning of capital markets or labour mobility); and governance instruments that provide overarching structures for engaging with industry and other relevant groups and ensure the co-ordination of all stakeholders.
- The *scope* of measures. It differentiates between horizontal measures which apply to a wider economy and vertical measures that are targeted at specific sectors, geographic areas or socio-economic groups.

The taxonomy of government support measures in industrial sectors

6. Government support for specific sectors can take different forms. In order to help frame the policy discussion and to guide governments in their disclosure efforts for different types of subsidies received by firms, the OECD has developed a taxonomy of support measures (OECD, 2023[3]). It builds on longstanding work to identify and measure government support across sectors. Support measures are categorised according to: (i) their formal incidence, i.e. the initial target of government support (e.g. enterprise income, the cost of intermediate inputs, labour and R&D), and (ii) their transfer mechanism, i.e. how the subsidy is generated (e.g. direct cash transfers, tax revenue foregone, or transfer of risk to government such as government loan guarantee).[2]

7. The type of government support received by firms tends to differ according to the sector in which they operate. In agriculture, support is often provided in the form of direct payments and by keeping domestic prices above international market prices (OECD, 2022[102]). In fisheries support includes subsidised inputs, such as fuel (OECD, 2020[136]). In energy sectors, including fossil fuels, subsidies often involve provision of energy to final users at below-market prices (OECD, 2021[137]). As for industrial sectors, government support generally involves a mix of government grants, tax expenditures, subsidised inputs and below-market finance (below market loan or equity injection) (OECD, 2021[132]).

[2] See Table 1 in OECD (2023[3]) for a complete overview of the taxonomy.

Annex C. Methodological challenges with evaluation of industrial policies

1. Important economic policy decisions should ideally rely on a comprehensive *ex-ante* evaluation or empirical evidence from similar measures, but this is challenging in the context of industrial policy, as discussed in this annex. Choosing the right evaluation metric is also not straightforward. While effectiveness in achieving a desired structural change is a common metric, it does not assess efficiency or alternative, lower-costs measures.[1] Finally, proposing convincing counterfactual scenarios to understand how different the whole economy would be without industrial policies is not easy (Juhász, Lane and Rodrik, 2023[4]).

2. A comprehensive and accurate *ex-ante* evaluation of industrial policies is inherently difficult. This reflects uncertainty about future developments for targeted sectors, and for the national and global economic environment. For instance, in the case of subsidies to develop domestic production of batteries, it is difficult to know if subsidised plants will succeed in producing and, in the longer term, if they will be profitable and competitive in global markets. The latter will depend on an uncertain evolution of input prices but also on changes in production technology and demand for batteries. A development of new technologies could require new types of factories and could lower demand for old types of batteries.[2] The success could also depend on other countries adopting similar subsidies, with implications for the domestic battery producers.

3. *Ex-post* evaluations of the effects of industrial policies are also challenging. A number of methodological issues make it difficult to identify causal impacts of these policies on specific outcomes: (i) these policies are generally without benchmarks, control groups or counterfactual; (ii) these policies are endogenous, i.e. they are not implemented randomly but in response to specific economic or political problems, which blurs the direction of causality between economic performance and industrial policy intervention; (iii) it is difficult to account for the role of spillovers and for the interdependence of outcomes of different actors (e.g. inter-industry effects or general equilibrium effects); and (iv) capturing potential long-run effects of policy intervention requires long time series, which are not always available. Furthermore, some industrial policy strategies are often one-off occurrences, making it challenging to eliminate the role of luck or confounding influences.[3]

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[1] This issue is especially pertinent for green industrial policies, as many alternative measures to limit greenhouse gas (GHG) emissions, like carbon pricing, exist (Meckling and Allan, 2020[159]).

[2] Technological progress could be indeed an important factor. For instance, in the case of solar cell production, technological upgrades have happened every two to five years, making old factories obsolete or in need of significant refitting (BloombergNEF, 2023). Similarly, a rapid technological progress in the production of wind turbines resulted in the massive increase in their size. Consequently, this has required costly adjustments along supply chains, including for their installation. These frequent adjustments raise questions about profitability in turbine markets.

[3] Usual econometric methods to estimate the causal effect of a policy, such as difference-in-difference estimators require to have a sufficient number of units exposed to the policy in order to be able to control for selection effects or confounding factors. Controlling for these factors is often necessary to fulfil the parallel trend assumption, which requires that in the absence of a treatment, the difference between the treatment and control group is constant over time. More recently, researchers have proposed other methods, such as synthetic controls, to estimate the effects of aggregate interventions affecting only a single unit or a small number of units, compensating for the lack of parallel trends by reweighting units to match their pre-exposure trends (Athey and Imbens, 2017[165]; Abadie, 2021[166]).

4. A growing number of studies have sought to overcome these challenges and to identify causal effects of various industrial policy measures (Annex D). Overall, empirical evidence about the effectiveness of specific measures in reaching the stated objectives is mixed. There is some evidence that well-designed economic incentives for R&D and good framework conditions can be effective in stimulating private R&D and innovation (Criscuolo et al., 2022[24]). Positive domestic effects have also been found for place-based policies (providing subsidies to firms located in disadvantaged areas) on firms' output growth, employment and investment, but not on productivity. These effects tend to be heterogenous across firms and over time. There are not many investigations of international effects of domestic subsidies.

5. Several case studies have investigated past national or regional strategies, reporting both cases of success and failures. Examples of documented successes include the support provided to heavy and chemical industries in South Korea in the 1970s (Lane, 2022[138]), or post-war Finland strategy to move away from agrarian economy (Mitrunen, 2021[139]). Researchers have also documented numerous failures of past industrial policies and identified the reasons for their lack of success (Rodrik, 2014[29]; Hufbauer and Jung, 2021[90]).[4] A number of country-specific and general cross-country analyses have stressed failures of import substitution policies in stimulating economic growth that were adopted in many Latin American countries in the post-world war II period (Fishlow, 1989[140]; Baldwin, 2000[141]; Aiginger, 2007[142]; Hasanov and Cherif, 2019[143]; Irwin, 2020[144]).

6. There is little empirical assessment of the effects of individual industrial policy instruments on resilience, inclusiveness, environmental[5] and the social aspects of firm performance. This partly reflects challenges with agreeing on benchmarks against which these outcomes can be evaluated. For instance, it is not clear how to operationalise the concept of resilience, partly due to the fact that it depends on the nature and duration of a shock (Goldberg and Reed, 2023[145]). The evaluation of complex industrial strategies is also scant (Annex D).

7. Few studies attempt to assess general equilibrium effects and global spillovers of industrial policies, beyond trade protectionism measures.[6] For instance, Attinasi, Boeckelmann and Meunier (2023[146]) seek to assess the spillover effects of the main provisions of the IRA (Annex A) on global production and trade via general equilibrium model simulations. They find substantive effects in the US sectors directly affected by the Act as well as non-negligible losses in specific EU sectors. However, a limited level of details in such models regarding sectoral disaggregation and policy instruments makes the calibration of actual industrial policy strategies difficult.

8. Not many empirical studies have evaluated welfare implications. Brawick, Kalouptsidi and Zahur (2019[131]) tackle this question focusing on China's industrial policy in the shipbuilding sector in the 2000s. They find that the policy generated mediocre results in terms of profit gains and consumer surplus, despite

[4] For instance, Hufbauer and Jung (2021[90]) provide scoring for 18 industrial policies in the United States over five decades based on three criteria (international competitiveness, implied costs per job saved or created in the supported sector, and support to frontier technology). See also Terzi, Singh and Sherwooed (2022[2]) for a review of industrial policies in the United States, China, Japan, and European countries, including examples of successes and failures.

[5] *Ex ante* estimates of the environmental effects are available for the IRA, as well as for other low-carbon fiscal spending measures. According to various model-based studies, the IRA could lead to an overall reduction of CO_2 emissions in the United States of between of 33% and 40% below 2005 levels by 2030 and between 43% and 48% by 2035 – compared to between 27% and 35% in 2035 without the IRA (Bistline et al., 2023[175]). A recent modelling exercise by the OECD estimates that recent low-carbon fiscal spending measures adopted after the COVID-19 crisis – including the IRA – could result in a reduction of GHG emissions by 1150 Mt CO2-eq in 2030 and by 1400 Mt CO2-eq in 2050 in OECD countries and the EU, compared to a reference scenario. This represents a 12% emission reduction in 2030 in the EU and North America (Aulie et al., 2023[15]).

[6] Several studies in contrast exist on the general equilibrium and global spillover effects of trade restriction measures. See for example Finck and Tillmann (2023[177]) or Bolt, Mavromatis and van Wijnbergen (2019[176]) for a literature review.

having positive effects on domestic investment, entry and market shares.[7] Choi and Levchenko (2021[147]) have tried to quantify long-term welfare effects of South Korea's heavy and chemical industry drive in the 1970s, and find that the policy overall had substantial positive welfare effects, mostly coming from long-term benefits of learning-by-doing rather than short-term benefits of relaxing financial constraints.

9. The multiplicity of objectives invoked to conduct industrial policies adds to the complexity of systematic evaluations of these policies. With many objectives, it is not clear how to weight their evaluations with the effectiveness of given measures varying across different objectives, especially if some objectives are met and others are not.

[7] Increasing market shares were obtained at the expense of the two former biggest players in the market, South Korea and Japan, which saw a significant drop in profits earned by their shipyards in the same period.

Annex D. Summary of empirical evidence about industrial policy effectiveness

1. Despite the renewed interests in industrial policies, empirical evidence on the effects of these policies is relatively scarce, as highlighted in various extensive empirical literature reviews (Warwick and Nolan, 2014[12]; Lane, 2020[34]; Criscuolo et al., 2022[35]; Juhász, Lane and Rodrik, 2023[15]). The paucity of evidence can be explained by methodological challenges highlighted in Annex C, and in particular the difficulty to identify causal impacts of industrial policies on specific outcomes.

2. A growing number of studies try to tackle the issue of causal identification and to evaluate actual impacts of industrial policies. They rely on microeconometric methods, either using quasi-natural experiments exploiting specific features of policies causing exogenous changes in eligibility, or using statistically constructed control groups (Lane, 2020[148]; Tagliapietra and Veugelers, 2020[149]). This emerging literature gradually expands the knowledge on specific outcomes of different types of targeted or untargeted policy interventions, although these techniques are often not easily applicable, either because the number of support beneficiaries is small or because support received is not comparable across beneficiaries (Rodrik, 2014[29]).

Public support to research and development can be effective to stimulate innovation

3. Numerous studies focus on the effects of support to research and development (R&D) through subsidies such as tax incentives or government grants. They find that these measures indeed stimulate R&D expenditure as well as innovation and economic performance of firms (Dechezleprêtre et al., 2016[150]; Howell, 2017[151]). The effects tend to vary across countries and firms, being larger for young and small firms than for large or multinational firms (OECD, 2023[25]). In contrast, evidence about the effectiveness of other instruments to support innovation, such as capital market interventions or public procurement for innovation, is mostly lacking (Warwick and Nolan, 2014[18]).

Place-based industrial policies are found to stimulate local employment and output, but not productivity

4. A large number of studies have tried to estimate the impact of European structural funds on regional economic growth. The results are mixed, ranging from positive, weakly positive or even negative effects, depending on type of fund considered and the estimation method used (Mohl and Hagen, 2010[152]; Becker, Egger and von Ehrlich, 2010[153]). Results from firm-level analyses of place-based policies on the other hand tend to find significant positive effects of public subsidies on output growth, employment and investment within targeted firms, but no positive effects on their productivity (Bernini and Pellegrini, 2011[88]; Criscuolo et al., 2019[31]; Branstetter, Li and Ren, 2022[89]). The effects tend to be heterogenous across firms (Becker, Egger and von Ehrlich, 2013[154]) and over time (Becker, Egger and von Ehrlich, 2018[155]).

Indirect effects of industrial policies on downstream and upstream sectors can be significant

5. Although the above-mentioned approaches do not capture aggregate effects of policies, some studies provide insights on the transmission of policies through linkages and on different types of spillover effects. For example, Blonigen (2015[156]) explores downstream spillovers of various types of industrial policy measures (export and production subsidies, government ownership, cartel arrangements and non-tariff import protection) in the steel sector in major steel-producing countries from 1975 through 2000.

He finds a negative effect, especially of export subsidies and non-tariff barriers, on downstream sectors export performance. In contrast, Lane (2022[138]) argues that South Korea's industrial policy in heavy and chemical industries in the 1970s has positively affected the development of downstream exporters in the long term, boosting their output and investment (while backward linkage to upstream sectors effects were limited). Similarly, subsidies for natural gas or coal can result in cheaper primary aluminium, which accounts for more than three-quarters of the production costs for semi-fabricated products of aluminium that are subsequently used in downstream industries like construction and production of aircrafts, cars, transmission lines, and food and beverage packaging (OECD, 2019[157]; OECD, 2023[158]). Subsidies for downstream industries can also increase the sales and profits of suppliers upstream. For instance, government support for the construction of new semiconductor factories may boost sales of specialised equipment and machines that can represent close to two-thirds of the costs of new facilities (OECD, 2019[134]).