Industrial strategies for tackling the challenges of the twenty-first century

Trends in objectives, rationales and design in policy and academia

Tommaso Ciarli
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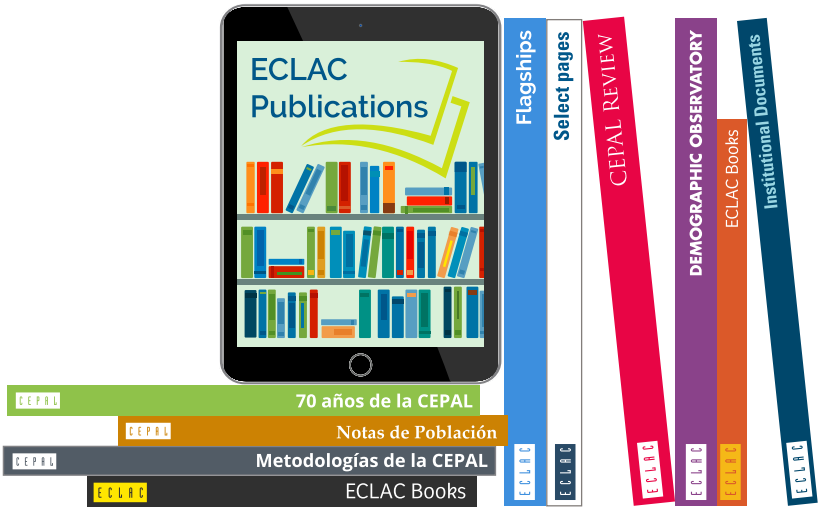

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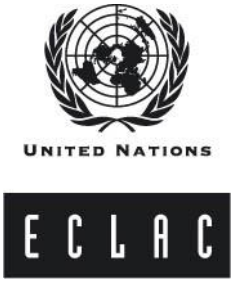

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Introduction

Interest in the role of industrial policy (IP), productive development policies, industrial strategies[1] and state activism more generally has risen again in recent years, especially in higher income countries, where investment in IP has been on the rise (Criscuolo et al., 2023; DiPippo et al., 2022; Juhász et al., 2022). While many of the arguments in favour of such an approach are not new, additional aspects including the threat of climate change, the COVID-19 pandemic, the acceleration, and direction of technological change in the digital realm, and increased international competition and geo-political positioning, have added to objectives and ambitions for intervention by governments through productive development policies. As such, traditional objectives, including the need to generate growth, productivity, and competitiveness, have been complemented with policies aimed at generating more resilient, innovative, inclusive, and sustainable development.

While the reinvigoration of industrial policy has been widespread, with increased efforts of governments in both developed and developing economies, the rationales for such interventions and the approaches adopted to implement them vary, in both academia and policy, and across countries. From a traditional perspective, the new challenges and objectives added to the realm of industrial policies can be classified under the rubric of market failures (Juhász et al., 2023). However, the complexity and interrelatedness of these challenges may invoke different rationales and strategies (Criscuolo et al., 2022), for instance, that look into coordinated missions, the direction of technical change, and the complex relations between different objectives. There are also differences between contexts in relation to the objectives that should be part of industrial policies, often related to the challenges prioritised in different countries.

[1] These terms are used in different contexts and literatures to refer to similar government interventions aimed at improving (sustainable) economic development leveraging the private sector. We refer to these interventions using these different terms interchangeably.

An important aim of the current project is to provide a mapping of these different objectives and rationales, as a means of providing insights for Latin American and Caribbean countries on the most appropriate industrial strategies available to meet the diverse challenges in the region. However, it is challenging to compare different industrial policies, *ceteris paribus,* because of the large number of definitions of what industrial policy is, and the variety of aims and rationales associated with IP.

This report thus seeks to systematise recent trends in industrial policy thinking and practice, linking the different definitions, rationales, and objectives, and providing examples on how these are related to different approaches to implement industrial policies. We do so in four steps.

First, we study the recent evolution of industrial policy objectives and rationales across countries by conducting a review of policy documents and grey literature since the start of the Covid-19 pandemic outbreak from various online repositories, including international organisations, country strategies and emerging quantitative comparative studies. The aim of this first step is to identify definitions, objectives, and rationales in the policy landscape, and how design and instruments may have changed in the industrial policy practice. We find that:

- The definition of industrial policies in recent country policy documents and international organisations focuses on economic objectives.[2]
- Despite the focus of the definitions, the objectives of the industrial strategies discussed in recent policy documents from international organisations and selected countries also include societal challenges and strategic issues. Recently, there has been a strong emphasis on issues related to environmental and climate change concerns (e.g., United States (USA), European Union (EU), Republic of Korea, United Arab Emirates (UAE)); the development of digital technologies and future technologies more generally; issues of fairness and equality; and issues of strategic autonomy. However, this seems to reflect mainly recommendations for high income countries, less so for middle- and low-income countries.
- The industrial strategies that were developed prior to the pandemic tend to have a lower (though non-zero) emphasis on issues of the environment, equality, and autonomy, with a larger emphasis on digital and new technologies. Underlying many of these objectives is the broader objective of developing and maintaining competitiveness, thus providing a link between these modern objectives of industrial policy and the more traditional motivations.
- The rationales mentioned to invoke industrial policies/strategies seem to have changed less than the objectives, although in some international organisations there is recognition that to address the societal challenges governments may need to intervene to direct technical change and increase our understanding of the complex relations among those challenges, complementing rationales based on narrower market failures. The rationales for industrial policy are less explicit in countries' industrial strategies, with objectives often considered as rationales.
- Besides the general reference to market failures, more specific rationales can be identified in the policy documents: directing technical change, particularly in the context of the digital and green transitions; structural transformation towards advanced manufacturing sectors and within sectors towards higher quality production; the creation of the conditions for production, particularly regarding infrastructure investments and of demand (e.g., for green goods); and framework conditions, especially in the EU (with a strong focus on regulations, standards, and certification).

[2] This is also the evidence that emerges from the quantification of industrial policy expenditure across OECD countries (Criscuolo et al., 2023).

- With respect to implementation, when dealing with the complexity of the challenges and of economic systems, international organisations highlight the importance of focusing on sets of instruments (i.e., strategies) rather than on single instruments and policies.
- The emphasis in recent strategies tends to be more strongly on technologies and products rather than sectors, which can either represent a focus on certain segments within broader sectors (e.g., electric vehicles) or technologies of a cross-cutting nature (e.g., artificial intelligence (AI) and machine learning). Technologies related to the digital transition (e.g., broadband access, quantum computing) and the green transition (e.g., electric vehicles, charging stations, carbon capture) have also often been the focus of recent strategies.
- In comparison with traditional views on the policies needed for industrial strategy, the recent examples considered tend to involve a movement away from a reliance on tariffs and taxes. Instead, a stronger focus is on the use of public money to engage in (and crowd-in) large-scale investments. These investments are often targeted at either infrastructure investments (including digital and green infrastructures) or innovation activities. Unsurprisingly, the extent of such spending tends to be larger in the more developed countries. Beyond these investments, policymakers are also required to develop institutional solutions and arrangements to deliver on the objectives, arrangements that become more complex with the pursuit of an expanding set of societal and strategic objectives.

Second, combining the grey literature reviewed in the first step and established academic literatures that have discussed conditions to achieve the objectives in the industrial strategies, such as innovation, technical change, and structural change, we classify objectives and rationales into, respectively, three and five related categories.

- Objectives are classified into: economic, societal challenges, and strategic.
- Rationales are classified into: structural transformation; creation of conditions for (and means of) efficient production; directing technological change; creation of framework conditions; and coordination and managing complexity.

Third, using the above classification we systematically map the recent academic literature on industrial policies over the last decade (2013-2023). We code academic publications according to their definition, objectives, rationales, and policy design (implementation). We find that:

- The literature on industrial policies has been growing significantly since the Covid-19 pandemic, especially in higher income countries.
- Although social objectives have been represented in the literature for the whole decade in higher income countries, they increased after the pandemic both in higher and lower income countries (where they had been less present before). Economic objectives still dominate, and strategic objectives appear crucially after the pandemic, mainly in higher income countries.
- With respect to rationales, academic publications on high-income countries continued to prioritize coordination and conditions for production but increased their focus on directing technological change since 2020. Publications on upper-middle-income countries maintained a strong focus on creating production conditions, and together with lower income countries intensified efforts in this regard and in directing technological change. The literature focusing on structural transformation is more relevant in countries with lower levels of income but showed mixed trends. These shifts likely reflect different economic and development stages of different countries.

We illustrate how these differences in objectives and rationales may reflect in the implementation of industrial policies exploring three cases, each from a different income group: Ethiopia, South Africa, and the UK.

Fourthly, we exploratively assess the correspondence (commonalities, gaps, emerging trends, etc.) of the recent academic literature and policy documents on instruments and strategies in terms of rationales and policy objectives.

- The discussion in the academic literature is related to the discussion in policy (both in international organisations and within countries).
- We observe that whereas policymakers in higher income countries are apparently moving towards more sophisticated strategies to address complex societal challenges and accelerate competition, emerging economies tend to focus on more specific instruments to address productive development objectives including gaining a greater participation in global value chains, generating domestic champions capable of exporting to high-income countries, attracting foreign investments, and so on. This distinction may represent a problem for emerging and lower income countries in the longer term, with such countries potentially left behind in terms of some global societal challenges.

The approach of combining academic literature with policy documents provides important complementarities. The academic literature provides important theoretical and motivational insights into the rationales for industrial policy and the major issues that industrial policy both faces and is designed to tackle, while the policy literature —both from national policy documents and from policy reports from major international organisations— provides a focus on the design and implementation of industrial policy. Combining these two literatures, the current report identifies two main recent shifts in industrial policies: the inclusion of broader social challenges related to sustainable development, and the design of coordinated industrial strategies addressing different objectives. We build on the above evidence to suggest a revised framework to think about industrial strategies (as opposed to policies), which carefully analyses the synergies and tensions between different objectives and rationales. We suggest that the distinction between different rationales may help in designing strategies that better address the related objectives. We finally discuss broad recommendations on objectives and rationales for industrial strategies in Latin American countries.

The structure of the document follows the four steps above. We first build our categories of objectives and rationales in the next section (section I), after reviewing a selected sample of reports published by international organisations and country offices. In section II we briefly summarise some of the main design and instruments and approaches discussed in the policy reports using these categories. The classification of objectives and rationales is instrumental in classifying the academic literature in the third section to analyse shifts in thinking about industrial policy since 2020 (section III). Section IV discusses the recent trends in industrial policy, based on the analysis of the academic and policy literature. This then motivates the revised framework to formulate policies and broad recommendations for Latin American countries.

I. A classification of definitions, rationales and objectives

A. Framing the study: definitions of industrial policy

Definitions of IP abound in the academic and policy literature (see annex 1). Differences between definitions depend mainly on the objectives of the IP and the areas of intervention and/or instruments used. Traditionally, the objectives of industrial policy have been related to economic performance (ranging from productivity, economic growth, welfare, and some of their main ingredients, such as technical change). We can distinguish between two groups of definitions related to those objectives: "structural" definitions that refer to policies that aim to modify the industry composition of an economy (usually with vertical policies),[3] and "horizontal" definitions that refer to policies that aim at improving efficiency across industries of the economy (Warwick, 2013).[4] Among the "structural" definitions, we can further distinguish between "narrow structural" definitions, referring to selective measures that are aimed to have an impact on specific industries[5] and "broad structural" definitions, referring to any

[3] For example: "Industrial policy is an attempt by a government to encourage resources to move into particular sectors that the government views as important to future economic growth." Krugman, P., Obstfeld, M., "International Economics Theory and Policy", 1991. Industrial policy is "aimed at particular industries (and firms as their components) to achieve the outcomes that are perceived by the state to be efficient for the economy as a whole." Chang, H.-J., "The Political Economy of Industrial Policy", St Martin's Press, 1994. Or "set of government measures – targeted at specific industries or firms – aimed at supporting the development and upgrading of industrial output" (Di Maio, 2014) p. 4.

[4] Industrial policy includes "everything which is useful to improve growth and competitive performance" Adams and Klein, "Industrial Policies for Growth and Competitiveness", Lexington Books, 1983. Or, "the activity which creates a favourable environment for European business in general, the manufacturing sector and its industries in specific" (Aiginger and Sieber, 2005: 6).

[5] "A policy that deliberately favours particular industries—or even firms—over others, against market signals, usually to enhance efficiency and to promote productivity growth for the targeted industries as well as for the whole economy" (Hauge, 2020).

measure that is intended to improve economic performance by shaping the productive structure, (as a whole or part of it) of an economy.[6] [7] According to Chang et al. (2013: 9) most analysts focus on the first definition and consider IP to be selective, i.e., targeted to specific industries.[8]

Definitions also differ with respect to the sector of intervention. On the one hand, traditional industrial policies tend to focus on interventions targeted at productive sectors of the economy (whether industry or services).[9] On the other hand, industrial policies are considered as part of a broader framework of measures aimed at modifying the institutional and innovative conditions of an economy (Cimoli et al., 2009a).[10] In this broader view, industrial policies also involve science, technology, and innovation policies (Cimoli et al., 2009b; Crafts and Hughes, 2014; Hughes, 2012), and may consider broader economic objectives, such as societal welfare. This broader approach to industrial policy is well reflected in the definition of Cimoli et al. (2006, pp. 1-2) who define industrial policy as any process affecting the economic and technological performance of an economy by "shaping the very nature of the economic actors, the market mechanisms and rules under which they operate, and the boundaries between what is governed by market transactions, and what is not." This definition allows for a variety of performance measures to be considered, with success also potentially measured in different ways depending on the objective.

More recently, especially since the Covid-19 pandemic, definitions in the academic and policy literature have further evolved in two main directions. In the "traditional" direction, definitions focus on economic performance. As before, they can differ along the structural/horizontal, and narrow/broad axes, ranging between narrow selective measures on specific sectors,[11] broader structural change,[12] and more general industrial competitiveness.[13] In this literature, definitions may focus on interventions targeted at productive sectors of the economy,[14] or extend beyond the industry focus towards broader interventions to improve the innovation system.[15] In the "new" direction, definitions extend to social welfare objectives beyond economic performance, including more general public goals,[16] such as inclusion, sustainability, and resilience.[17]

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6 "Any policy that shapes or influences the competitiveness of a country's firms and industries". Beath, J., "UK Industrial Policy: Old Tunes on New Instruments?", Oxford Review of Economic Policy, Vol. 18 No.2, 2002 Or, "it refers to policies that improve the structure of a domestic industry in order to enhance a country's international competitiveness" (Lee, 2013).

7 Beath (2002) proposes a distinction only between a narrow ("Restrict attention to policies that target particular firms and industrial sectors") and a broad view ("any policy that shapes or influences the competitiveness of a country's firms and industries").

8 For more discussion about traditional definitions of IP see also (Aiginger, 2007; Naudé, 2010; Di Maio, 2014; and Landesmann 2015).

9 "[A]ny type of government intervention or policy that attempts to alter the structure of production in favor of sectors that are expected to offer better prospects for economic growth in a way that would not occur in the absence of such intervention in the market equilibrium" (Pack and Saggi, 2006: 267-268).

10 "[A]*ny type of intervention* or government policy that attempts *to improve the business environment* or to alter the structure of *economic activity* toward sectors, *technologies or tasks* that are expected to offer better prospects for economic growth *or societal welfare* than would occur in the absence of such intervention" (Warwick, 2013: 16; italic in the original).

11 "[A] set of policies and programs explicitly designed to support specific targeted industries and technologies" (Atkinson, 2021, p. 0).

12 "IP role is changing the structure of an economy in either direction, magnitude, or speed, in a way that market forces alone would not be able to achieve" (Pineli et al., 2023).

13 "Interventions intended to improve structurally the performance of the domestic business sector" (Criscuolo et al., 2022 p. 4). "Industrial policy is cross-cutting in nature and aims to secure framework conditions favourable to industrial competitiveness." (EU general principles, 2023).

14 "Industrial policies refer to a series of policies using which the government intervenes in resource allocation and benefits distribution, restricts (compulsory), induces (incentives) corporate behavior, and influences the direction of industrial development" (Zhao and Yuan, 2021).

15 "We refer to a definition of industrial policies that encompasses all government interventions aiming at favouring growth which involves policies implemented in many fundamental institutional domains as education policies, research policy, legal framework protecting intellectual property rights" (Lechevalier et al., 2019).

16 "Those government policies that explicitly target the transformation of the structure of economic activity in pursuit of some public goal" (Juhász et al., 2023).

17 "Industrialization [policy] that drives development along the three aspects of inclusion, sustainability, and resilience" (Kastelli et al., 2023).

Table 1 summarises the range of definitions in the traditional industrial policy literature with respect to the vertical/horizontal dimensions, and the breath of objectives, with the table providing examples of traditional studies adopting such definitions.

Table 1
A systematisation of industrial policy definitions

Dimensions (vertical/horizontal)		Objectives		
		Economic performance		Social welfare
		Industry focus	Innovation system	
Structural	Narrow	Krugman & Obstfeld (1991) Chang (1994)		
	Broad	Lee (2013)	Lechevalier et al. (2019)	Kastelli et al. (2023)
Horizontal		Warwick (2013) Aiginger and Sieber (2005)		

Source: Authors' elaboration.

Because our aim is to study shifts in the policy and academic literature on industrial strategies, in this report we treat the definition of industrial policy flexibly. We consider industrial policy as all government interventions aimed at improving (sustainable) economic development by leveraging the private sector. Because (sustainable) economic development is broad, in this study we include documents that label such interventions as "industrial policy", "industrial strategy" or "productive development".

The differences between the definitions employed in the literature and summarised in table 1 are also related to different views on how to best achieve the objectives, presenting different theoretical rationales for why specific policy interventions are needed to achieve said objectives. Because different views and definitions of industrial policy depend on the objectives and on the rationales that explain why such objectives cannot be achieved without the policies, before systematically reviewing the literature, we next classify objectives and rationales, building on policy documents from selected countries and international organisations.

B. Objectives and rationales

While views about the nature and extent of state intervention in the economy vary substantially across different policy domains, the recent debate about industrial/productive strategies/policies has shifted from whether governments should use such interventions, to which policies are most effective, and how they should be implemented to be effective (Juhász et al., 2023). This is the view presented in publications of a variety of international organisations —such as the European Union, the International Monetary Fund,[18] Organization for Economic Cooperation and Development (OECD),[19] the United Nations Industrial Development Organization (UNIDO),[20] and the World Bank (WB).[21] This view reflects the increasingly well documented evidence that most high— and middle-income countries devote a substantial share of their budget to industrial/productive policies/strategies and publish reports and white papers describing them as essential to address several challenges.

[18] Hasanov and Cherif (2019).
[19] Criscuolo et al. (2022).
[20] https://www.unido.org/publications/policy-briefs.
[21] Hallegatte et al. (2013).

A number of studies have recently attempted to measure industrial policies across countries, using either budgetary data from different sources (Criscuolo et al., 2023; DiPippo et al., 2022) or counts of policies in official documents (Juhász et al., 2022). Although all three studies underestimate, by design,[22] the industrial policy interventions that they capture, they all show that the number and size of industrial policies has been large at least since 2019 (Criscuolo et al., 2023; DiPippo et al., 2022), and has been growing at least since 2010 (Juhász et al., 2022), especially in high income countries (Juhász et al., 2022).[23] For instance, figures show no less than 3.2% of GDP invested through grants, tax expenditures and financial instruments (e.g., loans), on average, across a sample of OECD countries (Criscuolo et al., 2023).

In this section we build on these studies, and on a non-representative small sample of policy documents from different countries and international organisations, to review how different policy makers (within and across countries) have framed industrial strategies in the years that have exposed some human challenges through financial, health and environmental crises. We use this evidence to identify a sample of objectives and rationales of industrial policies.

1. Views from selected international organisations

(a) Definitions of industrial policy

Documents published by international organisations (IO) use general definitions of industrial policies/strategies. Despite this, differences in definition exist with authors from the WB, IMF, and International Labour Organization (ILO) using "structural" definitions that explicitly refer to policies to modify the structure of the economy (in ways that depend on the goal), while authors from the EU and OECD tend to use "horizontal" definitions that refer to improving "structurally the performance of the domestic business sector" (table 2), where structurally refers to long term interventions rather than policies to address specific shocks, such as Covid-19. The focus in these definitions is mainly economic performance, with the exception of Hallegatte et al. (2013)– targeting green industrial policies, with an industry focus –and the EU (2023)– which refers to broad framework conditions (Table 3).

Table 2
Examples of definitions of industrial policies used in international organisations

International Organisation	Definition
OECD (Criscuolo et al., 2023, 2022)	"Interventions intended to improve structurally the performance of the domestic business sector." "A policy instrument is defined as a tool used by policymakers to affect performance outcomes in the business sector in order to achieve a pre-defined objective." "Industrial strategies are defined as a consistent and articulated group of policy instruments designed in order to reach specific policy objectives"
World Bank (Hallegatte et al., 2013)	Any non-neutral policy that implies distortions beyond the ones associated with revenue constraints, further defining green industrial policies as industrial policies with an environmental goal – or more precisely, as sector-targeted policies that affect the economic production structure with the aim of generating environmental benefits

[22] In the case of Juhász et al. (2022), exclusion is based on definition. For instance, they do not include sub-national policies such as place based policies, or policies that do not discriminate between sectors (such as horizontal policies, or those aimed at reallocating factors of production among different sectors ("between instruments") (Criscuolo et al., 2022)). Also, by using the Global Trade Alert as a source of policy documents, the policies are likely to be biased towards trade-based industrial policies, and for instance exclude most of the science and technology related industrial policies. In the case of DiPippo et al. (2022), they exclude most horizontal industrial policies. In the case of Criscuolo et al. (2023), they focus on the following instruments, which can be measured more accurately: tax expenditures, grants, government venture capital, loans and guarantees.

[23] This is important, as IP can give even more edge to countries that are already more competitive in the global market, making it even more difficult for other countries to catch up. Even more so as some of these policies are aimed at building strategic autonomy, i.e., de facto reducing imports from other countries, including lower income countries.

International Organisation	Definition
IMF (Cherif et al., 2022)	Targeted sectoral interventions
UNIDO[a]	Governments use industrial policy as a strategic approach to change the structure of their domestic economy. Industrial policy is motivated by a long-term goal – a vision of how the economy should be structured. These long-term goals can take numerous forms: growth, modernization, industrialization, etc. Industrial policy specifically seeks to change the relative prices across sectors or to direct resources towards selectively targeted activities (e.g. export, R&D), with the purpose of shifting the long-term composition of economic activity.
EU (2023)[b]	"Industrial policy is cross-cutting in nature and aims to secure framework conditions favourable to industrial competitiveness."

Source: Authors' elaboration based on references mentioned in the first column.
[a] https://www.unido.org/publications/policy-briefs.
[b] https://www.europarl.europa.eu/factsheets/en/sheet/61/general-principles-of-eu-industrial-policy.

Table 3
Types of definitions used in international organisations

		Economic performance		Social welfare
		Industry focus	Innovation system	
Structural	Narrow	Cherif et al. (2022)		
	Broad	UNIDO[a]		Hallegatte et al. (2013)
Horizontal		Criscuolo et al., 2023, 2022)	EU (2023)[b]	

Source: Authors' elaboration.
[a] https://www.unido.org/publications/policy-briefs.
[b] https://www.europarl.europa.eu/factsheets/en/sheet/61/general-principles-of-eu-industrial-policy.

(b) Objectives of and rationales for industrial policy in international organisations documents

Although the definitions used in the above reports may suggest that the aims for industrial policies are mainly related to traditional economic performance,[24] the observed increase in the use of industrial strategies in the past decade is related to the need to address wicked challenges, such as the climate emergency, resilience to health and other shocks, escalation in geopolitical competition and the related economic resilience (or strategic autonomy). These challenges have sparked an increase/change in the objectives of industrial strategies, the sectors addressed, the instruments used, and their governance (Rodrik, 2022).

Traditional industrial policies objectives such as innovation, productivity, economic growth (Criscuolo et al., 2022), competitiveness, employment (Hallegatte et al., 2013) and industrial diversification (Cherif et al., 2022), are still at the core of most current definitions of industrial policies discussed in IO reports. However, recent discussions about industrial strategies have broadened the aims to societal challenges, and resilience. With respect to social challenges, the most commonly discussed objectives are inclusion of disadvantaged firms and workers (within and across regions), the green transition (Criscuolo et al., 2022), green industrial restructuring (Hallegatte et al., 2013), the climate challenge and the energy transition (UNIDO, 2023; EU, 2023),[25] [26] digitisation, and the SDGs (OECD, 2021). With respect to resilience, the recent discussion in international organisations (mainly in the OECD (Criscuolo et al., 2022) and EU documents)[27]

[24] See for instance Curzon Price, V., "Industrial Policies in the European Community", 1981: "Industrial policy may be generally defined as any government measure, or set of measures, to promote or prevent structural change." Or Adams and Klein, "Industrial Policies for Growth and Competitiveness", Lexington Books, 1983: Industrial policy includes "everything which is useful to improve growth and competitive performance".
[25] https://www.unido.org/publications/policy-briefs.
[26] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en.
[27] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en.

focuses on strategic objectives such as the resilience of supply chains and the related strategic autonomy of countries with respect to critical material and inputs.

Despite the diversification of the objectives, the rationales that justify state intervention to direct the development of economies have not changed significantly with respect to the identification of market failures (Juhász et al., 2023). Large parts of the discussion focus on market and coordination failures, for instance failures in the provision of technologies and inputs that would enable diversification into more sophisticated (Cherif et al., 2022) or greener industries (Hallegatte et al., 2013) or that would improve firm efficiency (Criscuolo et al., 2022), the need to internalise the negative externalities related to environmental pollution (Hallegatte et al., 2013) and for efficient market regulation and control of market concentration favoured by digital technologies (Criscuolo et al., 2022). The framework proposed by the OECD (Criscuolo et al., 2022) makes a step forward, however, introducing more, and more diverse, rationales. For instance, they suggest that human challenges have become too complex and pressing and public impetus is needed to guide private investments. Related to this, they suggest that tackling societal challenges "may explain and justify the renewal of targeted industrial strategies, such as mission-oriented and technology-focused strategies". UNIDO (2023) proposes similar views, suggesting that the role of governments is to ensure that markets support public purpose, providing incentives to invest in addressing human challenges.

2. Views from selected countries industrial polices

Juhász et al. (2023) present a comprehensive overview of global industrial policies based on an extensive analysis of existing reports. Key trends identified include a widespread use of industrial policies, with an increasing trend over time. Notably, subsidies and export-related measures are prevalent, with trade financing, state loans, financial grants, assistance in foreign markets, local sourcing, loan guarantees, and import tariffs being prominent forms of industrial policy. The study emphasizes that industrial policies often target specific firms and are concentrated in a few developed countries, primarily focused on sectors with comparative advantages. The findings of Juhász et al. (2023) are reinforced by Criscuolo et al. (2023), who specifically examine nine OECD countries. This study reveals that industrial policies constitute a substantial portion of GDP expenditure, with a sectoral emphasis on digital and green transitions, alongside job and skill support. The analysis also highlights significant heterogeneity among countries and a recent rise in the importance of green industrial policy instruments.

The subsequent section delves into recent developments in industrial policies for various countries and regions, representing diverse levels of development. The focus is on strategies implemented post-Covid-19, with some examples from before the pandemic for comparison. While many countries have adopted industrial policies in recent years, the USA and the European Union stand out as particularly active in this regard, aligning with the trends identified by Juhász et al. (2023). Overall, the synthesis of these studies provides a nuanced understanding of the global landscape of industrial policies, emphasizing their prevalence, sectoral targeting, and concentration in specific developed regions.

(a) Objectives of and rationales for industrial policy in selected countries documents

The analysis of recent country strategies reveals that the rationales for industrial policy are often implicit, with objectives serving as de facto rationales in many cases. Rather than explicitly stating why public policy interventions are necessary, these strategies predominantly focus on addressing major global challenges as the primary justification for their adoption.

In the United States, a diverse set of rationales and objectives underpin various recent strategies. Societal challenges and strategic autonomy take precedence, with environmental sustainability the main societal challenge addressed. The Bipartisan Infrastructure Deal, established in 2021, aims to upgrade national infrastructure and enhance competitiveness, with a significant

emphasis on mitigating climate change through energy innovation. The strategy includes efforts to improve transport infrastructure with a focus on environmental sustainability, such as the development of electric vehicle (EV) chargers, power infrastructure upgrades, and enhancements to the public transport system. Similarly, the European Union's recent policy initiatives, exemplified by the European Green Deal, prioritize climate change and environmental degradation as major pillars. The objective is to transform the EU into a resource-efficient and competitive economy, with a commitment to achieving net-zero greenhouse gas emissions by 2050 and decoupling economic growth from resource use.

Outside the USA and EU, climate change and sustainability are present in industrial strategies but often take a secondary role. For instance, while the Republic of Korea's Korean New Deal highlights eco-friendly energy infrastructure, renewable energy use, and green clusters, the primary strategy focus lies elsewhere. The United Arab Emirates' Operation 300bn strategy mentions clean energy solutions and sustainable practices but maintains a predominantly economic focus. Strategies developed before the Covid-19 pandemic, such as Thailand's Thailand 4.0 and China's Made in China 2025, also incorporate elements of green technologies and sustainability but prioritise digital technologies and economic development.

In the case of Made in China 2025, the strategy acknowledges concerns about energy utilisation and environmental pollution. While not central, green development is an objective to combat climate change and environmental impacts, with the strategy emphasising sustainable development, energy-saving technologies, and environmental protection. The strategy further underscores the importance of increased research and development in advanced energy-saving technologies, promotion of low-carbon production, and recycling to enhance resource utilization efficiency.

Recent industrial policy strategies reveal diverse objectives beyond climate goals, with a strong emphasis on other societal challenges, notably inequality and inclusiveness. In the USA, equality issues are embedded in strategies like the Inflation Reduction Act, addressing healthcare equity, and the Bipartisan Infrastructure Deal, targeting access to clean water and high-speed internet. The EU's Green Deal aims to leave no person or place behind, addressing regional disparities. The Korean New Deal prioritises employment and social safety nets to enhance population resilience, while the UAE focuses on talent attraction and workforce skills.

A further recurring theme in many countries is strategic autonomy, driven by concerns over supply chain disruptions and in some cases increased competition, from China specifically. In the USA and EU, recent strategies stress the importance of resilience and vertical integration within supply chains, with the CHIPS and Science Act and EU industrial strategies aiming to strengthen domestic supply chains, particularly in critical sectors. And China's own Made in China 2025 strategy has a focus on reducing dependence on foreign technologies.

Economic objectives are also prominent in recent strategies, aligning with traditional industrial policy goals. Strategies such as the CHIPS Act and Made in China 2025 aim to boost domestic manufacturing, create jobs, and enhance competitiveness. China's strategy also emphasizes local innovation, smart manufacturing, and structural optimization.

Digitalization is a cross-cutting objective, linking to societal challenges, strategic autonomy, and economic goals. The EU's digital strategy aims to make it a global leader in digital technologies, while Thailand's 20-year strategy (Thailand 4.0) and China's Made in China 2025 prioritize digital transformation. Digitalization is also integral to the Korean New Deal and the broader EU strategy.

Directed technical change is also evident, particularly in strategies focusing on the twin transitions of digitalization and green transformation. The Endless Frontier Act in the US explicitly establishes a Directorate for Technology and Innovation. The emphasis on developing key technologies

and sectors is evident in strategies like China's Made in China 2025 and the Korean New Deal. Relatedly, the EU's New Industrial Strategy highlights the need for substantial structural change, aligning with the digital and green transitions.

Finally, developing framework conditions is a critical aspect in the EU's industrial strategy, emphasising the role of the EU as an enabler and regulator. The EU seeks to set frameworks, provide political direction, and coordinate activities for industrial ecosystems.

Overall, recent industrial policy strategies demonstrate a shift towards directed technical change, structural transformation, and digitalization as major objectives of industrial policy, aligning with global efforts to address societal challenges, enhance strategic autonomy, and achieve economic objectives.

C. Rationales for industrial policies: bridging industrial policy and innovation literature

Since country documents do not distinguish the rationales of industrial policy from its objectives, we complement the views of international organisations on rationales with other sources of literature. Based on the definitions and objectives discussed, we extend beyond the literature on industrial policy (mainly focused on market failures) and include the literature that discusses the conditions needed to achieve industrial policy objectives through innovation, thus providing a broader and deeper understanding of the varied rationales for policy intervention.

Most of the literature on industrial policy justifies state intervention based on evidence that the market alone does not provide the incentives to invest in areas that are beneficial to achieve some of the objectives discussed above, such as modifying the structure of an economy, or investing in environmentally friendly technologies. The market failure approach is mainly concerned with the optimal allocation of resources and designing market-based incentives to address these failures, such as by rewarding positive information externalities and reducing coordination failures, which can emerge from underinvestment in infrastructure (Hausmann and Rodrik, 2006). For example, industrial policies can aim at reducing coordination failure through fiscal incentives and reducing barriers to invest in infrastructures. The focus on market failures as a rationale for industrial policy is though both crucial and incomplete, given the prevalence of market failures (Juhász et al., 2023). For instance, Cimoli et al. (2009b) suggest that the traditional view of market failures as being the primary reason for industrial policy is flawed, not because market failures are not relevant, but because in terms of what may be considered the leading yardsticks of market failure (e.g., market completeness, knowledge possessed by economic actors, perfectness of competition, etc.) the "whole world can be seen as a huge market failure."[28]

A system failure approach, instead, fosters dynamic competitiveness, defined as "the ability of firms, regions and countries to increase economic growth, to make use of and to develop the given resources, and to comply with the long run objectives" (Aiginger and Sieber, 2005: 233). Industrial policies should also aim at designing institutions or framework conditions that can guarantee the

[28] They highlight a number of areas for potential intervention by governments, including: Technological learning; Entrepreneurship, incumbent organisations, and development; Institutions to support an extensive structural transformation; Policies targeting the appropriation of knowledge and opportunities for imitation; The generation of incentives and rents in the political economy of learning; Institutions and the determination of boundaries between non-market and market interactions; The generation, adoption and economic exploitation of new scientific and technological knowledge; Policies aimed at facilitating complementarities, creating incentives, and overcoming coordination hurdles; And policies to facilitate the coevolutionary dynamics between the institutional development of technological capabilities, organisations and incentive structures. Beyond this broad list, Cimoli et al (2009b) highlight the need to ensure consistency between macro and industrial policies, the complementary importance of labour relations, income claims, property rights and culture, and the centrality of the firm and its capabilities in industrial policy.

sustainability of the economic (innovation) system, which includes the market (Aiginger and Sieber, 2005). From the systemic perspective, the objectives also include the reshaping of institutions and the creation of an active developmental state (Mazzucato, 2013).[29]

Besides the difference between market and systemic failure, to review the different shades of rationales for industrial policies, we look beyond the literature on industrial policy, into the literatures that have discussed conditions to achieve its objectives, such as innovation, technical change and structural change (Ciarli et al., 2019). These include the literature on science, technology and innovation, such as innovation systems (Freeman, 1995), industrial innovation (Breschi et al., 2000), properties of technical change, missions and technological programmes (Gross and Sampat, 2023; Kantor and Whalley, 2023), and structural change (Cimoli and Porcile, 2009; McMillan et al., 2014).

Industrial policy literature. Pack and Saggi (2006) summarise several *market failures* that require government intervention to redirect the economy, such as knowledge spillovers and dynamic scale economies (Bartelme et al., 2019), imperfect knowledge markets and low appropriability (Arrow, 1962), innovation and agglomeration externalities (Crafts and Hughes, 2014), and imperfect capital markets for nascent industries (Hasanov and Cherif, 2019). Hausmann and Rodrik (2003) add that determining profitability of new economic activities is costly, undermining *economic discovery* (Hausmann et al., 2007). *Coordination failures* may also inhibit private actors from investing in a given industry, especially if this requires inputs from other industries which may not be available domestically or too expensive to import (Hausmann and Rodrik, 2006; Pack and Saggi, 2006; Rosenstein-Rodan, 1943). Lastly, *system(ic) failures* can arise from different sources (Hughes, 2012), such as coordination failures in investing in new technologies, which require capabilities that are not available at the country level, and which need institutions, infrastructure, skill creation; institutions and regulations; and knowledge, market, and financial conditions for actors to innovate in more competitive technologies (Soete, 2007; OECD, 1999).

Properties of technical change as a complex system. Innovation is the key determinant of development and structural change (Metcalfe, 2014). It affects their pace and direction, which in turn affects challenges of sustainable development identified in some of the more recent social objectives of industrial policy. Besides failing to internalise some of the social benefits (or costs) of innovating, firms fail to see the systemic nature of technical change. Technical change is deeply uncertain in its process, outputs, and outcomes. A single organisation is unlikely to even consider the potential implications. For instance, although electric vehicles are widely considered as a sustainable alternative to mobility, their environmental impact in the long term is far from understood. Moreover, technical change generates inequalities, as knowledge and innovation clusters in space and organisations (Kaldor, 1981; Balland et al, 2020; Autor et al, 2020). Apparent imbalances in knowledge production and use shape innovative activities in directions that can be more or less useful to address different challenges (Ciarli, 2022). The

[29] Consider export competitiveness, for example. The specific objectives through which it can be achieved vary significantly. From the market failure rationale, an increase in exports is considered an objective, independently from the good exported, since comparative advantages would drive trade towards the appropriate specialisation pattern. From a systemic approach, increases in exports are considered together with export specialisation. Exports of low added value products may be penalised to promote domestic product upgrading. Export promotion in sectors with high value added is likely to be accompanied by incentives to import capital goods (like in China). Such measures may also be adapted in a relatively short time, reflecting changes in the technologies and the global distribution of production, and the role of the state in directing economic change. The coordination of industrial policies to address objectives that are beyond economic growth and competitiveness, and address also broader societal challenges, can also be approached in different ways. One approach to coordination is to leverage investments in the private sector to address sustainability goals, directing private investments in science and technology (S&T) (OECD, 2021). A second approach is to define coordinated industrial strategies across different objectives. An example is the UK industrial strategy, which aimed at addressing several challenges, from AI to aging, but also included a set of "sector deals" to bolster the international competitiveness of strategic sectors, while also addressing societal challenges (Balawejder and Monahan, 2020; Ciarli et al., 2019). A third approach is that of missions to directly invest in S&T in order to give it a directionality (Mazzucato, 2013).

outcomes and output of innovation are influenced by an intricate web of interactions between those who contribute to the innovative activities and the users of innovations, which has the properties of a complex system (Arthur, 2013; Kirman, 2010).

For instance, the rate and way innovations and new technologies affect economic welfare is largely determined by their diffusion (Hall, 2004). Following from the literature on technology diffusion, the first rationale for intervention is then to help in *promoting diffusion of new technologies*, by reducing costs (including adaptation and complementary investments), increasing information, reducing protection, and speeding up legitimisation. At the same time, diffusion can lead to the privileging of suboptimal technologies (David, 1985) through simple market interactions (Arthur, 1989; Salganik et al, 2006). A second rationale is thus related to the *lock-in in incumbent technologies*, i.e., a situation where non-optimal technologies are difficult to be replaced by "superior" technologies.

Because advances in knowledge, innovation, and technology affect different people, in both negative and positive ways (Ciarli, 2022), industrial policies are also needed to consider the distribution of benefits and gains. The need to design inclusive industrial and innovation policies is also related to the evidence that innovators come from privileged backgrounds (Aghion et al., 2017; Bell et al., 2016). If the large majority of the population does not have the opportunity to contribute to the production of knowledge a large number of resources are not used (Akcigit et al., 2020), which may not be efficient. Rodrik (2023) proposes a different approach to define objectives of industrial policies, emphasising that economic choices need to be made by governments and civil society and not by a few large corporations. Policy is needed to ensure that the involvement of a variety of actors can contribute to shaping the direction of science and technology (S&T).[30] For instance, what are the implications of AI research being directed by a few companies (Mateos-Garcia et al 2023)? A third rationale is thus related to the *systemic failure in identifying in a democratic way what are the directions of innovation that humanity hails*, beyond a few innovators. It is therefore possible "for government policy to improve social welfare by influencing the rate and direction of technological change" (Steinmueller, 2010, p. 1184).

National Innovation Systems. The first rationale that we identify in this literature is *technological foresight*: providing information on the scope of future technologies in which to invest and directing firms' incentives in investing into them (Martin and Irvine, 1984). For instance, Freeman (1987) noted the crucial role of state agencies in Japan –such as the Ministry of International Trade and Industry (MITI)– in shaping the direction of technical change and the dynamic allocation of resources of private actors. The second rationale is the need to proactively *link different actors of an innovation system*, including to facilitate knowledge exchanges. Besides firms, an innovation system is comprised by a set of institutional actors, the networks among them and broader aspects of the national communities (Freeman, 1982; Lundvall, 1992; Nelson, 1993). Universities, government funding, suppliers and users promote technological advance, together with private investment (Rosenberg and Nelson, 1994). Substantial empirical evidence suggests that public agencies, such as universities and public research institutions, are central in the generation and establishment of new technologies, and an essential feature of sustained economic growth (Cimoli et al., 2009a; Dosi, 1984). Building innovation systems goes beyond market failures and entails building the institutions that allow the market itself to work. This includes the institutions that govern the functioning of long-term industrial policies (Valero and van Ark, 2023).

Sectoral systems. The literature on sectoral systems shows that the conditions for firms to innovate and increase productivity differs between sectors (Malerba and Mani, 2009; Malerba and Orsenigo, 1997). For instance, Malerba et al. (1997) differentiate industries according to *technological regimes* characterised by: opportunity conditions (the probability to successfully innovate for given R&D investments); appropriability conditions (capacity to appropriate innovation outcomes and therefore

[30] See, for example, evidence that innovations from ethnic and gender minorities are less used (Cheng and Weinberg, 2021), and that low representation of women in science biases health research towards male diseases (Koning et al., 2021).

rents, with and without intellectual property right regulations (IPR)); degrees of cumulativeness of technological knowledge (the relevance of existing tacit and codified knowledge to further innovate); and characteristics of the relevant knowledge base (the sources of knowledge nurturing the innovative activities). They show how differences with respect to technological regimes shape patterns of innovations, industrial organisation, and dynamics as well as firm incentives and capacities. As these conditions and properties of innovation differ across industries, so should policies aimed at improving conditions for innovation and productivity.

Missions and technological programmes. The concept of mission-oriented innovation policy was originally put forth in the 1980s in the context of technology policy linked to specific projects of national strategic relevance, such as building technological capabilities for military uses (Ergas, 1987), or in areas where firms did not have adequate market incentives to participate (Cantner and Vannuccini, 2018). Recent evidence shows that such missions have had a substantial impact on the rest of the economy and innovation system, well beyond the intended missions (Gross and Sampat, 2023; Kantor and Whalley, 2023). More recently, missions have attracted a great deal of attention as a potential way to address grand societal challenges such as global warming (Foray, Mowery, & Nelson, 2012; Bloom et al., 2019). A mission-oriented approach is not only concerned with the intensity of innovative activities, but more fundamentally in influencing its direction (MOIIS-IIPP,2019; Cantner and Vannuccini, 2018; Mazzucato, 2018). In this respect, the so called "new mission orientation" for innovation policy is set to address a range of long-run failures or grand societal challenges characterised by both high levels of uncertainty and unknown demands for future innovations (Cantner and Vannuccini, 2018). The first rationale for public interventions from this literature is therefore to address *long-run market failures and intergenerational inconsistencies*. The second rationale raised by this literature is that of *creating new markets* (rather than sectors) where firms can invest in the future, once there is enough demand. A third rationale is the role of financing for innovations. While under some conditions venture capitalists might be ideal, according to Mazzucato and Semieniuk (2017) and Mazzucato and Penna (2015) *public financing is needed in the case of long term, blue-sky, highly risky investments* (usually in technologies of strategic national relevance, or to address societal challenges).

Structural change. The existing productive specialisation and technological trajectory of an economy determines its future productive and technological developments (Cimoli and Porcile, 2009; David, 2000). This is because introducing new technologies requires a costly change of existing technologies, capabilities, practices, and institutions that have developed around given technological paradigms (Katz, 2006; 2012), i.e. a large sunk cost. Policies may be needed to *modify the production structure* of an economy towards sectors that are more likely to spread technological upgrading. This requires the *acquisition of knowledge and capabilities* that may not be present in the economy, which may need policy intervention especially when the knowledge and technology frontiers are far from the current capabilities (Cimoli et al, 2009).

D. A classification of industrial policy objectives

By the objectives of IP, we refer to the specific aims that a government wishes to attain with specific measures (e.g., industrial policy instruments). As suggested by the reviewed examples of international organisations and country experiences (section 0), objectives can vary from broad (e.g., industrialization, increased competitiveness) to specific (e.g., reduction of water consumption in the productive process, increase in the ratio of R&D expenditure to GDP, etc.).

The traditional literature suggests several objectives that have been addressed with industrial policy (section 0). A general objective that follows from a broad definition of industrial policy is increasing the level of investment and aggregate productivity, and more generally economic performance. Narrower definitions of IP reflect more targeted objectives related, for example, to the performance of given sectors

in terms of indicators such as output, employment, and exports. For example, Greenwald and Stiglitz (2013: 57) maintain that the "objective of IP is to shift production toward sectors in which there is likely to be more *societal learning*, meaning more learning and more learning externalities" (our italics).

The focus of the narrower objectives of IP shift across countries and periods. For instance, structural change and industrialisation (predominant in the reconstruction of the post-WWII period), have to some extent given way to broader aims of social learning and competitiveness in the neoliberal era. Evidence of premature deindustrialisation in lower income countries, though, has raised the question of whether policies targeting industrialisation are not the main aim for these countries (see for instance the examples of Operation 300bn in UAE[31] and the industrial policy action in South Africa).[32]

The definition of industrial policies in recent country policy documents and international organisations focus on economic objectives (section 0). This is also the evidence that emerges from the quantification of industrial policy expenditure across OECD countries (Criscuolo et al., 2023). The objectives of the industrial strategies discussed in recent policy documents from international organisations, though, also include societal challenges and strategic issues, besides the economic objectives. The climate change emergency (Criscuolo et al., 2022; McGuire and Paunov, 2022; OECD et al., 2021) and strategic autonomy (McGuire and Paunov, 2022; OECD et al., 2021) seem to dominate the debate in international organisations and across countries, although reference is also made to inclusiveness (McGuire and Paunov, 2022; OECD et al., 2021) and digitization (McGuire and Paunov, 2022). However, these objectives seem to reflect mostly reports and strategies from high income countries, less from middle- and low-income countries.

Such differentiation in objectives also reflects the different industrial strategies across countries. In the most recent examples considered, there is a strong emphasis on issues related to environmental and climate change concerns (e.g., USA, EU, Republic of Korea, UAE), with important differences in their relevance between countries. Other objectives that have been a major component of recent country strategies —particularly those of the USA and the EU— include the development of digital technologies and future technologies more generally. Conversely, the strategies that were developed prior to the pandemic tend to have a lower (though non-zero) emphasis on issues of the environment, equality, and autonomy, with a larger emphasis on digital and new technologies. Underlying many of these objectives is the broader objective of developing and maintaining competitiveness, attempting to compromise between these recent objectives of industrial policy and the more traditional ones.

We summarise the objectives reviewed in three categories.

(i) *Economic Objectives*, such as competitiveness; innovation; economic growth; and employment.

(ii) *Societal Challenges*, such as inequality and inclusiveness; climate change and environmental sustainability; digitalisation, artificial intelligence, and other emerging technologies; demographic transition, youth bulge, and ageing population; and intergenerational challenges (e.g., demography, climate, wealth inequality, inclusiveness).

(iii) *Strategic Objectives*, such as resilience; strategic autonomy; and long-term planning (foresight).

We next move to discuss the rationales, in relation to different objectives and definitions.

[31] https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/industry-science-and-technology/the-uae-industrial-strategy.

[32] https://www.gov.za/sites/default/files/gcis_document/201805/industrial-policy-action-plan.pdf.

E. A classification of industrial policy rationales

Building upon the literature (section 0) and the discussion above highlighting new and broader aims and objectives of industrial policies (section 0), we consider a rationale for industrial policy to involve the *development of arguments that justify the use of government policy / intervention over a laissez-faire market-based alternative to achieve objectives related to the performance of the productive sector, in ways that can contribute to moving forward, rather than backward, on the path to overcoming social challenges and achieving strategic objectives, and in ways that contribute to investing in science, technology and innovation as a means to achieve the desired objectives*. This definition of a rationale, consistent with Criscuolo et al. (2022), covers the whole productive sector (not just manufacturing) and is, in principle, applicable to firms with different ownership structures (e.g., private firms, state-owned firms, cooperatives).

With the aim of consolidating the rationales discussed in Section 0 with the objectives summarised in section 0, we identify five broad and non-exclusive categories of rationales consistent with the above definition. These are as follows:

(i) Structural transformation:
This first rationale is a broad one that acknowledges that individual actors (e.g., firms), even when working in concert, may not have the knowledge, resources, or influence to engender broad-based structural transformation, with the need for a central authority to provide, resources, coordination, and direction for such transformation. This need may be because of network externalities or other causes of path dependency, multiple equilibria, or market failures. In thinking about structural transformation, a broad view is taken including the development of new sectors, activities, and occupations, as well as efforts to diversify the economy and to modify the production structure (in both a static but also dynamic sense through encouraging and investing in innovation). In this sense, shifts towards the green economy and to sectors insulated from the negative effects of technological change could be considered under this rationale. This rationale is related to the fifth rationale about coordination.

(ii) Creation of the conditions for (and the means of) efficient production:
Not unrelated to the above rationale, this rationale focuses on the role of government in providing such things as infrastructure to meet firm needs, but also in creating and enhancing factors of production (e.g., through specific education programmes), in creating production activities (e.g., the provision of public goods), and either directly or indirectly creating demand for firms. This is strongly related to the presence of market failures, such as, if there are no market incentives to produce public goods, but is also related to systemic failures: production of goods and services thrive when tangible and intangible resources are easily accessible (e.g., creation of agglomeration externalities, including infrastructures). Moreover, one of the conditions to increase the efficiency of production is innovation, which is uncertain, costly, and not always appropriable.

(iii) Directing technological change:
The focus of this rationale relates to the role of government in pushing out the technological frontier and in influencing the direction of technological change. One of the rationales for intervention is to encourage technology upgrading and alter the dynamic allocation of resources through changing the incentives for innovation and technological change, which is uncertain, costly, and not always appropriable. Another rationale is path dependency and the risk that technical change may result in lock-in in suboptimal trajectories: public organisations have a role in exploring alternative trajectories that seem less promising in the short run. Governments also need to make sure that technological trajectories are not driven by a few private corporations, which may not reflect the priorities of different components of the society (e.g., in health research). Beyond institutional building, this rationale also links to the role of government in

providing and encouraging basic science, engaging in technology foresight and related activities, and in the generation of general-purpose technologies.

(iv) Creation of framework conditions:
The fourth rationale differs from the second one (directly intervening in markets through creating production and demand) and focuses on the need for governments to create the institutions and rules to regulate different markets, e.g., to facilitate the transfer of technology and knowledge, solve information asymmetries, and correct positive and negative externalities.

(v) Coordination and managing complexity:
The final rationale has complementarities with the other four rationales and involves the government correcting coordination and systemic failures, generating interdependencies between different actors, linking the private and the public sector, and linking firms within the private sector (innovation systems). Besides generating interdependencies, public intervention has a further role in understanding how these and other interdependencies influence the impact of firm activities on social objectives, including engagement in technology foresight and related activities. Ultimately, therefore, the rationale is linked to navigating the complexity of technical change.

Table 4 combines rationales and objectives in a single matrix that we can use to study the evolution of industrial policies in policy, practice, and academia in a coherent way. More importantly it can be used to guide policy discussion to identify which policy interventions are needed for a combination of objectives. That is, what is the rationale, and role, of public intervention, its boundaries and evaluation. Below, we make use of table 4 to systematise the objectives, rationales, and example of instruments disused in the sample of international organisation and countries discussed in this paper. In section III we use the table to discuss specific instruments based on the academic literature.

Table 4
Proposed classification of industrial policies connecting rationales and objectives

Rationales		Structural Transformation	Creation of conditions for (and means of) efficient production	Directing technological change	Creation of framework conditions	Coordination and managing complexity
Objectives	Examples					
Economic Objectives	Competitiveness Innovation Economic growth Employment					
Social Challenges	Inequality Inclusiveness					
	Climate change / Environmental sustainability					
	Digitalisation Artificial intelligence New technologies					
	Demographic transition Youth bulge Ageing Population					
	Intergenerational challenges (e.g., demography, climate, wealth inequality, inclusiveness)					
Strategic Objectives	Resilience Strategic autonomy Planning (foresight,...)					

Source: Authors' elaboration.
Note: The table combines the proposed categories of objectives and rationales of industrial policies based on documents from international organisations, countries, and the academic literature on innovation and technical change. Resilience refers to the ability to respond to and overcome shocks; Digitalisation concerns the adoption and diffusion of such technologies, but also managing their impact on the economy/society; Societal challenges will also include the SDGS more generally, perhaps linked to engagement in 'global agendas'.

Table 5
Examples of main rationales of industrial policies discussed in the documents of international organisations

	International Organisation			
Rationales	OECD (Criscuolo et al., 2023, 2022)	World Bank (Hallegatte et al., 2013)	IMF (Cherif et al., 2022)	UNIDO[a]
Structural Transformation		Discover latent comparative advantages		
Conditions for production	Access to inputs (e.g., skills, knowledge, infrastructure); demand to increase scale; knowledge externalities (appropriability)	Complementary inputs	Intermediate goods; skills; infrastructure	
Directing technical change	Missions to address challenges			Support public purpose technologies
Framework conditions	Sound competition; well-functioning capital markets; governance of new GPTs such as AI			Markets and institutions are co-created by public, private and third sectors
Coordination & managing complexity	Complementarities between policy instruments; complexity of challenges	Complementary activities; negative externalities; knowledge spillovers; coordination failures; capital market imperfections	Learning externalities; coordination failures	
Other	Concentration of digital firms; Machine learning improve industrial policies			

Source: Authors' elaboration based on references mentioned in the table heading.
[a] https://www.unido.org/publications/policy-briefs.

Table 6
Examples of main rationales of industrial policies discussed in country strategies

Rationales	Country Strategy					
	United States	European Union	China	Republic of Korea	Thailand	United Arab Emirate
Structural Transformation	(Selective) reindustrialisation; Shift to clean energy technologies	New areas of production and work linked to green and digital transition	Upgrade and encourage higher quality production ("structural optimisation")	Develop new industries	Develop new industries	
Conditions for production	Accelerate introduction of productivity-enhancing manufacturing technologies	Complementary inputs (e.g., infrastructure and capacity in energy networks)	New production methods, industry forms, and business models; Generate indigenous innovation	Creation of new markets; Development of infrastructure	Infrastructure development; Investment in skills	Adoption of advanced technologies
Directing technical change	Address emerging challenges; Develop new technological areas	Innovation to meet emerging challenges (specifically environment related); Disruptive and breakthrough innovation				
Framework conditions		EU as a regulator and enabler: Provide political and policy direction to create certainty for private sector; Ensure a level playing field	Legislation and standards to improve institutional environment	Developing framework conditions for the twin transition; Institutions to accelerate private sector investment in innovation	Access to markets, information, and finance	Generate attractive business environment
Coordination & managing complexity	Build supply chain resilience	Co-design and co-create solutions;	Coordinating role linking government, firms, academia, and research institutes			

Source: Authors' elaboration based on country policy documents.

¡Error! No se encuentra el origen de la referencia. and **¡Error! No se encuentra el origen de la referencia.** show results from an exercise that summarises the industrial policy *rationales* discussed more or less explicitly in selected International Organisations and country strategies, respectively. With regards to the selected International Organisations, we observe a variety of different rationales, the most common being the *creation of the conditions for (and the means of) efficient production* together with *coordination and managing complexity.* Both combine several market failures such as access to inputs, externalities, and complementarity between policies. With the exception of the OECD documents (Criscuolo et al., 2023, 2022), there is no mention of addressing the complexity of innovation and the challenges they address. It is interesting to note that only one of the documents explicitly refers to *structural transformation* rationales and only two documents refer to the creation of framework conditions, which are the rules and regulations that enable the achievement of the objectives of industrial policies. It is also interesting that at least two organisations refer explicitly to the need for public intervention to influence the *direction of technical change*, although the focus is on technology missions to address complex human challenges. In terms of the country strategies, it is more difficult to distinguish rationales from objectives. Despite this, there are some commonalities across the different strategies with many of them highlighting the importance of developing new industries as an important rationale for the strategy, with the more developed economies further emphasising innovation and technological change to develop new and emerging technologies. Many strategies also emphasise aspects relevant to generating the conditions for production and framework conditions, though often from quite different perspectives. In the former case, strategies refer to more traditional rationales related to infrastructure and skill development, with others focusing on the development of new production methods, new markets, and new business models. In the latter case, the rationales range from more traditional aspects, such as government-university-industry links, to the co-creation of solutions, ensuring a level playing field, and providing policy direction.

Turning to our selected example of countries' industrial policy documents (China, EU, Republic of Korea, Thailand, UAE, and USA) (table 6), as for international organisations, the most common rationale is the *creation of the conditions for (and the means of) efficient production*. That is, addressing some of the most common market failures, related to creating infrastructures, incentivising the production of complementary inputs, creating markets, or attracting investments. Differently from international organisations we notice a more frequent focus on rationales related to *structural transformation*. This is related to the need to incentivise a stronger investment in manufacturing, especially in strategic industries related to digital and green technologies (EU, and USA), increasing diversification of production and exports (Republic of Korea and Thailand), and shifting production towards more high-tech products (China). We also observe a less frequent reference (implicit or explicit) to *coordination and managing complexity,* mainly focused on improving links between different economic actors internationally (e.g., GVCs in the USA) or domestically (e.g., linking government, firms, academia, and research institutes in China).

Rationales related to *framework conditions* differ across countries, reflecting the different regulatory needs. In the EU, documents refer to the need for creating regulations across countries of the union, reducing regulatory differences between countries. In the Republic of Korea the focus is on institutions that incentivise private firms' investment in new technologies especially related to the twin transition. Whereas in Thailand the need is to improve access and functioning of markets for firms to access exports, finance, and information. Finally, rationales related to *directing technical change* are more explicit in the EU and the USA, with a focus on investing in technologies to address emerging challenges (mission oriented) and competing at the technological frontier. Similarly, in China the focus is on the need to substitute foreign with indigenous creation of key technologies.

Following the overview of rationales observed in national policy documents and reports from international organisations, table 7 summarises the main *objectives* discussed in these reports and strategies. With regards to international organisations, all documents discuss relatively similar *economic objectives*, including innovation, productivity, and sectoral transformation for economic growth and competitiveness, but also jobs and providing intelligence for business investment. Most documents further discuss other *social challenges*. The most common is the climate emergency. Less frequent are issues of inequality, quality of jobs, and inclusion and sustainable development more broadly. Only one of the organisations reflects more recent *strategic objectives*, focusing on strategic autonomy and resilience.

Table 7
Examples of main objectives of industrial policies discussed in selected international organisations documents and in country strategies

Objectives	Economic	Social challenges	Strategic
OECD (Criscuolo et al., 2023, 2022)	Innovation; productivity; economic growth; competitiveness	smoothing transition costs; fostering economic activity and employment in disadvantaged areas; SDGs; inclusion of firms and workers	Strategic autonomy; Resilience
World Bank (Hallegatte et al., 2013)	Competitiveness; green jobs	Green industrial restructuring	
IMF (Cherif et al., 2022)	Strategic autonomy; Resilience		
UNIDO[a]	Guiding business expectations about future growth areas, and catalysing activity	Climate change; energy transition	
United States	Infrastructures; Competitiveness; Manufacturing; Employment;	Environmental sustainability (energy innovation); health care; equity; regional disparities	Strategic autonomy; national security (defence); emerging/critical technologies
Objectives	Economic	Social challenges	Strategic
European Union	Competitiveness; (green) Jobs; Infrastructures; Structural transformation (digital); Economic growth	Climate change; environmental degradation; regional disparities	Strategic autonomy; security; technology autonomy; Framework conditions
Objectives	Economic	Social challenges	Strategic
China	Manufacturing (advanced); Innovation capabilities; Efficiency; Competitiveness; Structural transformation	Environmental impacts; health impacts	Technology autonomy
Objectives	Economic	Social challenges	Strategic
Republic of Korea	Employment; Innovation, Investment; Structural transformation (digital)	Energy transition; social security	
Thailand	Digital technologies	Clean technologies	
United Arab Emirate	Economic growth; Competitiveness; Productivity	Clean energy	Strategic autonomy (skills)

Source: Authors' elaboration based on reports from international organisations and national policy documents.
[a] https://www.unido.org/publications/policy-briefs.

With regards to the selected countries, we find a similar picture. All countries cover many similar *economic objectives* to increase competitiveness. These objectives range from infrastructures (USA and EU) to investment in digital technologies (all countries). The EU, Republic of Korea, and the USA are also relatively more concerned with jobs than other countries, which have a stronger focus on growth and structural change (besides digitisation). The EU and the USA further contend with China a focus on manufacturing. All countries also include other *social challenges*, with the common denominator across all being the climate emergency. The EU, Republic of Korea, and the US also

include objectives related to inequality and health. Most countries also include reference to strategic objectives, the most common being strategic autonomy, albeit defined in terms of different specific objectives (e.g., technologies in China, skills in UAE, and access to materials in EU and USA). In the EU and US, the strategic objectives are also tied to national security (including defence, a traditionally dominant driver of industrial policy). In the EU, framework conditions to coordinate policies across countries is also relevant.

II. Instruments, tools and approaches

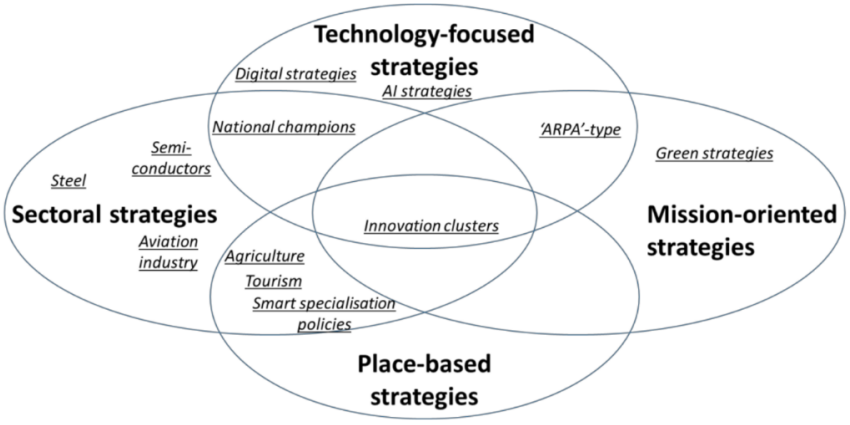
A. Views from international organisations: from policy instruments to industrial strategies

To increase the impact and success of industrial policies, the OECD framework (Criscuolo et al., 2022) suggests a more systemic use of policy instruments, especially when the objectives combine complex, interrelated, challenges. They propose to combine several policy instruments into coordinated industrial strategies, rather than focusing on individual instruments. This view concurs with the idea that most of the challenges discussed in the objectives (Section 0 and Table 7) are interrelated —addressing one challenge may be helpful or harmful for others[33]— and that to transform economies to being more sustainable, several components of the system need to change —e.g., from infrastructures to consumer behaviour in the case of the green transition. For instance, sustainability scholars have called for policy mixes to address the green transition (Rogge and Reichardt, 2016).

In this context, the OECD framework delineates four strategies (Diagram 1): traditional sectoral strategies to build capabilities in competitive sectors that trigger economic growth in the rest of the economy; mission-oriented strategies to achieve specific and well framed missions, which could range from technological achievements to addressing societal challenges; technology-focused strategies to spur the production and/or diffusion of innovations; and place-based strategies, to redistribute productive opportunities across regions, as well as creating regional poles of attraction.

[33] For example, increasing productivity and consumption may lead to more greenhouse gas emissions, while the transition to electric vehicles, requires access to critical materials, increasing dependency on fragile value chains. The negotiations that have led to the SDGs themselves have underlined that challenges of sustainability are interconnected (Ciarli, 2022; International Council for Science, 2017).

Diagram 1
The Organisation for Economic Co-operation and Development's four types of industrial strategies



Source: Criscuolo et al. (2022).

Different strategies use different combinations of instruments, are suitable for different objectives, and are supported by different rationales. In table 8 and table 9, we classify the objectives and rationales of each of the four strategies, building on Criscuolo et al., (2022), using our proposed classification (table 4). With respect to objectives (table 8), sectoral and technology-focused strategies and instruments are considered mainly in relation to economic objectives (innovation and productivity). More recently, sectoral strategies and instruments also focus on strategic objectives (strategic autonomy and access to upstream sectors). Mission oriented strategies and instruments mainly focus on societal challenges (green strategies, technology accelerators, public health, and other grand challenges) and to some extent resilience. Placed based strategies and instruments mix economic objectives (regional productivity and economic growth) with the regional distribution of economic activities (for inclusion and equity).

Table 8
Main objectives of industrial strategies in the Organisation for Economic Co-operation and Development framework

		Strategies			
		Sectoral	Mission oriented	Technology focused	Place based
Objectives	*(Examples)*				
Economic	Competitiveness Innovation Economic growth Employment	Innovation and productivity growth		Innovation, diffusion, productivity	Productivity and economic growth
Societal Challenges	Inequality Inclusiveness	Target sectors with middle aged workers			Regional distribution of economic activity (inclusion)
	Climate change / Environmental sustainability		Green strategies		
	Digitalisation Artificial intelligence New technologies		Accelerators		
	Demographic transition Youth bulge Ageing Population Health		Public health		
	Intergenerational challenges (e.g., demography, climate, wealth inequality, inclusiveness)		Grand challenges		
Strategic	Resilience	Upstream sectors	Resilience		
	Strategic autonomy	Strategic autonomy			

Source: Authors' elaboration based on Criscuolo et al. (2022).

Table 9
Main rationales of industrial strategies in the Organisation for Economic Co-operation for Development framework

	Rationale				
Strategies	Structural Transformation	Creation of conditions for (and means of) production	Directing technological change	Creation of framework conditions	Coordination & Managing Complexity
Sectoral	Learning by doing Natural monopolies	Enabling upstream sector			Uncertainty Several (compatible) simultaneous investments (vertical coordination)
Mission Oriented		Creating the conditions for the public sector to justify the investment in directions beneficial to society	Address the direction of innovation (coordination across policy domains) Address societal objective not catered by firms	Regulatory uncertainty	Simultaneous investments in different industries
Technology focused		Upstream sectors			High uncertainty of radically new technologies
Place based	Marshallian externalities	Marshallian externalities			

Source: Authors' elaboration based on Criscuolo et al. (2022).

Rationales (table 9) are similar for sectoral, technology-focused, and place-based strategies and instruments, and include:

- Structural transformation – due for instance to positive scale externalities, e.g., through learning by doing (sectoral strategies) and Marshallian externalities (place-based policies).
- Creation of conditions for (and means of) production – such as enabling the conditions for investment in upstream sectors (sectoral strategies), or generating more general Marshallian externalities (place-based strategies).
- Coordination failures – such as due to the need to coordinate several investments across different sectors (sectoral strategies), and the uncertainty of innovation processes (technology-focused strategies).

In a similar way to how objectives for mission-oriented strategies also differ with respect to the other three strategies, the rationales for mission-oriented strategies differ from the first three strategies. They do include the creation of conditions for and the means of production (e.g., creating the conditions for the public sector to justify the investment in challenges) and coordination failures (coordination of several investments and challenges that do not attract private sector investment) but they also appeal to the need to direct technological change (to address societal objectives not catered by firms) and create the right framework conditions (to reduce the uncertainty around regulations that may change to address challenges, e.g., in the case of low carbon transitions).

In sum, we notice the following main developments in thinking about industrial policies in the selected international organisations reports:

- The rationales mentioned to invoke industrial policies/strategies seem to have developed less than the objectives, although in some international organisations there is recognition that to address the societal challenges government may need to intervene to direct technical change and increase our understanding of the complex relations among those challenges.
- With respect to implementation, when dealing with the complexity of the challenges and of economic systems, it seems important to focus on sets of instruments rather than on single instruments and policies. Although Juhász et al. (2023) suggest that governments have not yet internalised the relevance of coordinating different policies into strategies, some countries have been adopting more systemic industrial strategies (e.g. UK, EU, China), and this is also the recommendation of some of the reports from international organisations (e.g., Criscuolo et al., 2022). For example, the recent EU industrial strategy combines different policies, such as the green and digital transitions, in relation to both strategic autonomy and sustainability objectives —although the extent to which the EU accounts for synergies and trade-offs is not made explicit in the policy documents.[34]

B. Views from selected countries industrial strategies: the changing nature of country industrial policies

In Annex 2 Selected countries industrial strategies we describe in some detail the instruments and design of the strategies of the countries selected in this study. In table 10 we classify a selection of these instruments according to our categories of objectives (table 4). The aim is not to provide a complete list of instruments, but to present the diversity of policies used to address objectives across countries. Most instruments are related to economic objectives. In the EU and USA, we see a focus on innovation (both R&D and diffusion), whereas in China and Thailand we see a stronger focus on economic competitiveness and productivity. Among the social challenges we note the strongest focus on environmental sustainability and digitisation. Instruments range from regulations to incentivise development and adoption of both green and digital technologies in the private sector, creation of infrastructures, and direct investment in new technologies (technological missions). These different instruments are based on different rationales ranging from market failure in investing in technologies that have a social benefit that is higher for society than for private companies (e.g., tax incentives), creating the conditions for production (e.g., infrastructures), and directing technical change (e.g., technology missions). Finally, instruments for strategic objectives are less common, and mainly used in higher income countries for improving GVCs and access to materials, or in China in relation to creating the conditions for creating frontier technologies indigenously.

[34] For instance, according to the general principles of EU industrial policy "Industrial policy is cross-cutting in nature and aims to secure framework conditions favourable to industrial competitiveness. It is also well integrated into a number of other EU policies such as those relating to trade, the internal market, research and innovation, employment, environmental protection, defence and public health." Based upon such a definition "[t]he EU's industrial policy aims to make European industry more competitive so that it can maintain its role as a driver of sustainable growth and employment in Europe. The digital transition and the transition toward a carbon-neutral economy have led to the adoption of various strategies to ensure better framework conditions for EU industry. The impact of the COVID-19 pandemic and the war in Ukraine have sparked new reflections on economic recovery, on reconstruction and on building resilience."

The discussion of country strategies in annex 2 and table 10 provides a limited and highly selective review of recent industrial policy strategies. Despite this, it provides some useful insights and is largely aligned with evidence from the recent systematic attempts to quantify the extent, scope, and approach to industrial policy (Criscuolo et al., 2023; Juhász et al., 2022, and DiPippo et al., 2022). These insights can be summarised as follows:

- In comparison with traditional views on the policies needed for industrial strategy, the recent examples considered tend to involve a movement away from a reliance on tariffs and taxes. Instead, a stronger focus is on the use of public money to engage in (and crowd-in) large-scale investments. These investments are often targeted at either infrastructure (e.g. digital and green) or innovation activities. Unsurprisingly, the extent of such spending tends to be larger in high income countries.
- In the limited number of strategies considered, there is often a differentiation of policies and instruments by development level. Perhaps the most obvious distinction is between those countries that focus on the diffusion and adaptation of technology and those seeking to push out the technological frontier, with the former seeing value chains and trade agreements as an important means to achieve such outcomes.
- The European Union represents something of an exception with respect to policy instruments. While significant funding is provided to encourage and facilitate the innovation and investments needed for the twin transition in the case of the EU, the strategy documents have a stronger emphasis on framework conditions, and specifically issues related to regulation, standards, and certifications, than other countries and regions. This likely reflects the split of the responsibilities of the EU vis-à-vis national governments when it comes to industrial strategy and its implementation.

Table 10
Example of objectives of industrial policy instruments in selected countries

Rationales		United States	European Union	China	Republic of Korea	Thailand	United Arab Emirate
Objectives	*Examples*						
Economic Objectives	Competitiveness Innovation Economic growth Employment	Investment in R&D, manufacturing and workforce development	EU competition policy to level playing field; New standards and technical regulations; EU funding programmes (e.g., Horizon Europe, European Social Fund)	State-owned banks providing subsidies, low-interest loans, and bonds; target use of local intellectual property; Targets for R&D and labour productivity; investment in quality control and management mechanisms; institutional reform	Investment in training	Development of Eastern Economic Corridor through infrastructure investment to enhance connectivity with rest of the world; development of one-stop service centres to simplify regulatory processes; Tax holidays, reduced personal income tax rates, reduction in corporate tax rates; long term land leases, exemption from import duties and work visas for firms investing in corridor	Expansion in number of trade agreements; reforming industrial laws; lowering energy costs for industry; flexible financing for priority sectors; simplifying registration, licensing and fee procedures
Social Challenges	Inequality Inclusiveness				Universal unemployment insurance scheme		
	Climate change/ Environmental sustainability	Infrastructure investments; Tax incentives, grants, and loan guarantees; Investment in climate-related technologies; Consumer tax credits for green products; Loan programs office for new energy technology projects	Large scale innovation projects; Public-private partnerships		Infrastructure investments		
	Digitalisation Artificial intelligence New technologies	Support for the manufacturing and development of semi-conductors; Direct support of production facilities; Tax credits; Loan guarantee programs; Workforce development; Grants to construct, expand, and modernize domestic facilities and equipment; Investment tax credits and loan guarantee; Investment in research and development; Accelerators (Manufacturing USA); Funding applied and translational research	Development of quantum communication infrastructure and enabling technologies		Investment in digital infrastructure		
Strategic Objectives	Strategic autonomy		Regulations on screening of foreign direct investment; Increased recycling				

Source: Authors' elaboration based on country policy documents.

III. The recent academic literature on industrial policy: objectives, rationales, and implementation

A. Methods

This systematic literature review aims to identify and map recent trends and shifts in industrial policies, focusing on rationales, objectives, and policy instruments. To achieve this, the review employs the SALSA methodology (Systematic Approach for Literature Search and Analysis) based on 4 steps: search, appraisal, synthesize and analysis (Grant and Booth, 2009). The SALSA approach allows us to provide a comprehensive understanding of how the industrial policy literature has evolved in the last decade, shedding light on the current state of the academic discussion, and offering insights into what has changed by mapping the rationales and objectives found in the literature into our categories.

The systematic search involves designing a comprehensive search strategy to identify a corpus of academic articles from various sources, minimising potential biases and ensuring that relevant studies are not missed. We draw on the Dimensions database of Digital Science, a comprehensive research database that provides access to a wide range of research outputs, as the primary source of academic literature. This database provides bibliographic details as well as full-text access to approximately 100 million publications in addition to various citation and altimetric metrics, including information on the overall scientific impact and visibility of research outputs (Hook et al., 2021). Moreover, a key advantage of using Dimensions is accessing preprints and working papers including, for instance, SSRN and NBER working paper series, which are not covered in other repositories. Given the well-known long time-lags from submission to final publication, accessing preprints is essential to provide insights into emergent research (Hook et al., 2021). In terms of coverage, Dimensions includes a wide variety of specialized sources in terms of geographies and topics beyond more traditional indices, such as the Directory of Open Access Journals, the China Journal Initiative, SciELO from Latin America and the Caribbean, and UGC-CARE from India, among others. Still, we acknowledge that our search strategy and the repository are limited in scope insofar as we only use search terms and review work published in the English language.

Our search strategy relies on combinations of relevant keywords used in several search strings. In particular, we use as an anchor "industrial policy" (including variations and wildcards) in combination with different keywords linked to policy objectives and rationales as outlined in our classification in table 4 (e.g., "productivity, "sustainability", "missions", etc.), along with other terms related to the implementation and evaluation of industrial policies, such as "instruments, "design", "rationales", "implementation", "evaluation", and "effectiveness".[35] We devise, attempt, and collect results from several queries with different combinations of these different keywords. In terms of parameters and filters, we limit our query to articles, book chapters, and preprints published between the years 2013 and 2023 (inclusive), in the following fields of study: Human Society, Economics, and Commerce, Management and Tourism. Based on these different queries, listed in the annex 3, we identified an initial set of 2,887 publications.

Subsequently, we establish the selection criteria to determine the inclusion of a given article in our review. First, we filter the set of publications according to their academic relevance based on a threshold of citations. More specifically, we select the publications belonging to the upper 20% of citations by year of publication. The application of this quantitative criteria left us with 591 publications for further screening. Second, we determine the relevance of the publication to our study by reading the title and abstract of each paper. We also exclude publications covering a level of analysis not informative for this paper e.g., highly granular geographical disaggregations such as cities or individual firms. We also exclude publications that are purely analytic without a link to policies (e.g., computational models of the economy), and publications that are off topic (e.g., concerned with management practices or international businesses). At this point, we are left with 237 publications for full-text reading and coding.

Out of these 237 selected records, a total of 169 documents were successfully coded. The discrepancy is explained by several documents that were only available in languages different from English[36], lack of relevance and/or technical quality when reading the document, and a random selection of documents for oversampled countries (e.g., out of 46 documents on China, we randomly included 21 in the analysis). The full list of coded documents is available in annex 4.

Moving to the appraisal and coding of the corpus of documents, we developed a coding scheme that allows us to organize and analyse the industrial policy academic literature in relation to definitions, objectives, rationales, and implementation. Below we detail the coding categories and provide a brief description:

General

- *Is an IP definition given?*: This category indicates whether the industrial policy (IP) is explicitly defined in the publication or not.
- *If yes, what is the definition*: If a definition of the industrial policy is provided, this category captures the specific definition stated.
- *Geographical focus*: This category records the geographical scope or focus of the publication (e.g., national, regional, international) and indicates the country/region of study.

Rationales (as defined in section 0 and listed in Table 4 Proposed classification of industrial policies connecting rationales and objectives).

[35] For replicability, we detailed the search queries in the Annex 3.

[36] As mentioned, our search strategy focused on English-language publications. While non-English academic literature may occasionally offer English translations for titles and abstracts (and therefore be retrieved by our search strategy), the absence of English full texts prevented coding. An exception is that we were able to include a few cases with full text in Spanish in our analysis.

- *Structural Transformation*: individual actors (e.g., firms), even when working in concert, may not have the knowledge, resources, or influence to engender broad-based structural transformation, with the need for a central authority to provide, resources, coordination, and direction for such transformation.
- *Creation of the conditions for (and the means of) efficient production*: role of government in providing such things as infrastructure to meet firm needs, but also in creating and enhancing factors of production (e.g., through specific education programmes), in creating production activities (e.g., the provision of public goods), and either directly or indirectly creating demand for firms. This is strongly related to the presence of market failures if there are no market incentives to produce public goods but is also related to systemic failures.
- *Creation of Framework Conditions*: need for governments to create the institutions and rules to regulate different markets, e.g., to facilitate the transfer of technology and knowledge, and to solve information asymmetries, or correct positive and negative externalities.
- *Coordination and managing complexity*: involving the government correcting coordination failures, generating interdependencies between different actors, linking the private and the public sector, and linking firms within the private sector. Besides generating interdependencies, the public intervention has a role in understanding how these and other interdependencies influence the impact of firm activities on social objectives, including the engagement in technology foresight and related activities.
- *Directing technological change*: pushing out the technological frontier and in influencing the direction of technological change directly or altering the dynamic allocation of resources.

Objectives (as defined in section o and listed in Table 4 Proposed classification of industrial policies connecting rationales and objectives).

- *Economic objectives*: for instance, productivity, economic growth, innovation, and employment.
- *Societal challenges*: for instance, inequality and inclusiveness; climate change and environmental sustainability; digitalisation, artificial intelligence, and other emerging technologies; the demographic transition, youth bulge, and ageing population; and intergenerational challenges (e.g., demography, climate, wealth inequality, inclusiveness)
- *Strategic objectives*: for instance, resilience, strategic autonomy, and long-term planning (foresight).
- *Other objectives*: additional objectives beyond the predefined categories.

Policy design and implementation

- *Selective IP?*: indicates whether the industrial policy is selective, targeting specific sectors, technologies, or products.
- *If yes, what sector/technology/product?*: specifies the sectors, technologies, or products targeted by the selective industrial policy.
- *Instruments*: records the policy instruments used to implement the industrial policy.
- *Instrument description*: provides a brief description of the instruments and their main characteristics.
- *Design features*: indicates whether specific design/implementation features are available.
- *If yes, what features?*: further details on design and/or implementation features.
- *Evaluation*: indicates whether the industrial policy has been evaluated.
- *If yes, what type of evaluation? Main results*: specifies the type of evaluation conducted and the main results obtained.
- *Methods*: specifies the research methods used in the publication

The primary focus of the analysis is to capture differences, similarities, and trends in terms of the rationales and objectives underlying industrial policies. By systematically categorizing the stated rationales (or the implicit rationales when not explicitly mentioned), such as addressing market failures, promoting structural transformation, or directing technological change, we aim to identify the main motivations for the implementation of industrial policies across the academic literature, and whether the prevalence of different rationales has changed over the last decade. By systematically categorizing the objectives, we analyse the specified economic, societal, and strategic objectives of the policies to discern patterns and variations in the desired outcomes they seek to achieve.

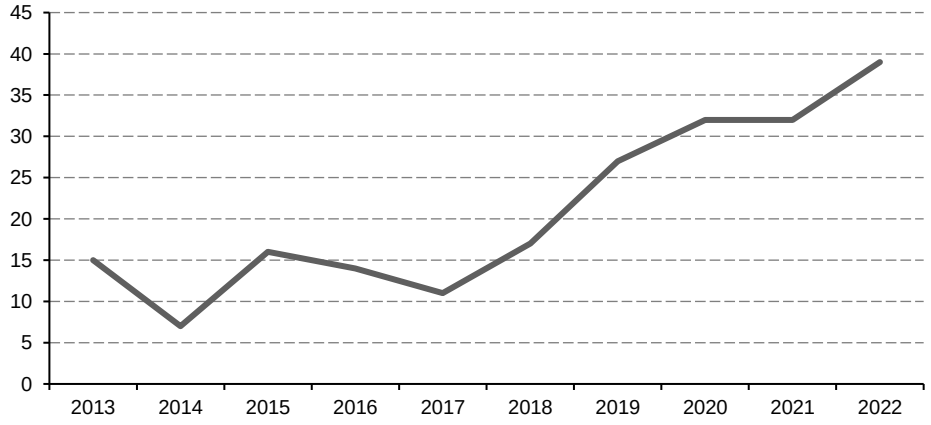
Furthermore, the analysis involves a detailed exploration of the design and implementation features of the industrial policies discussed in the academic literature. By examining the recorded policy instruments and their descriptions, we identify common approaches employed to implement these policies. The aim is to capture specific design features that may differentiate industrial policies, including the context of implementation, framework conditions related to institutional arrangements and targeting (e.g., sector-specific targeting or technology-focused interventions). Additionally, we investigate whether certain design features, such as technology-focused interventions, are prevalent in connection with specific objectives and/or rationales and, if so, what design features, technologies, or products are typically targeted.

B. Results

Our first finding is a clear upward trend in the volume of academic literature on industrial policy over the past five years. According to

Figure , the number of publications discussing industrial policy rose from a yearly average of 13.9 publications in the pre-pandemic period (2013 to 2019) to 32.5 in the years 2020 to 2023. This increase underscores a burgeoning interest and engagement with industrial policy matters that began already in the aftermath of the global financial crisis of 2008 (Stiglitz et al., 2013), and that seems to be further fuelled after the pandemic and increasing preoccupation with the climate emergency.

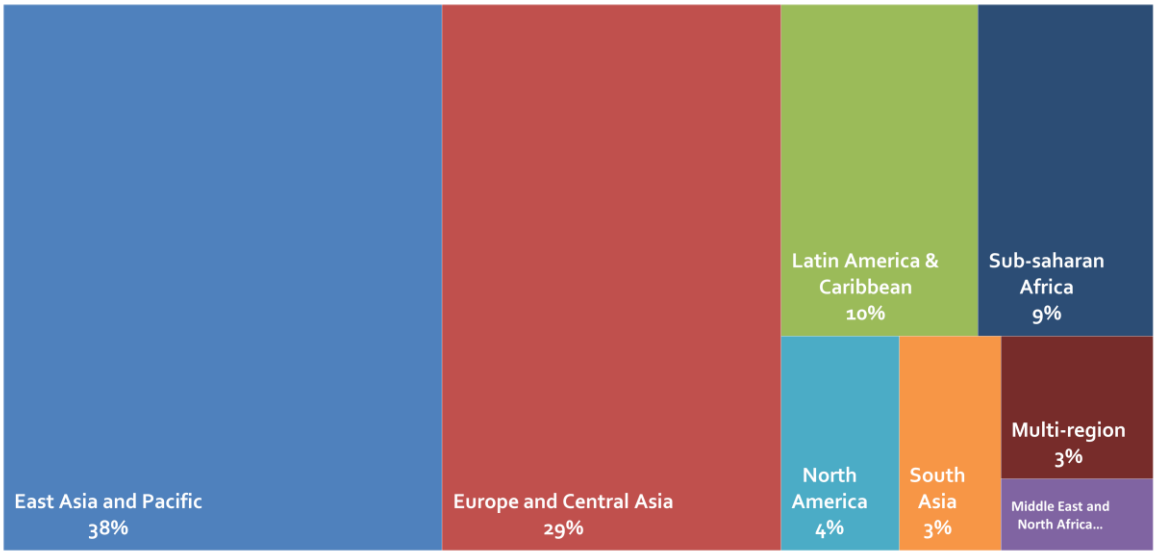
Figure 1
Evolution of academic literature on industrial policy by year of publication, 2013-2022
(Number of documents)



Source: Authors' elaboration.
Note: The figure includes all 237 relevant papers (including those not coded because of quality or country oversampling).

In terms of the geographical scope of the literature,[37] we find a global interest in industrial policy that is skewed toward countries in the northern hemisphere and that have higher levels of income.[38] As shown in figure 2, we find that the largest share of publications – 38% in total – focus on East Asia and the Pacific, with a marked predominance of China within this group (representing around 70% of the documents within the group). The second largest share discusses Europe and Central Asia countries (29% in total). Latin America & Caribbean and Sub-Saharan Africa, represent a similar share of our corpus (10% and 9% respectively), while North America and South Asia follow with relatively lower shares (4% and 3%, respectively), and the Middle East and North Africa region shows very limited coverage (less than 2%). Finally, 3% of the papers fall under the category "multi-region," as they encompass countries across several geographic regions. The rest of the documents show no geographical focus (54 out of the 237 collected papers) and are concerned with a broader discussion, frequently theoretical and conceptual, without engaging in the examination of specific countries or regions.

Figure 2
Share of industrial policy literature by geographic regions, 2013-2022
(Percentages)

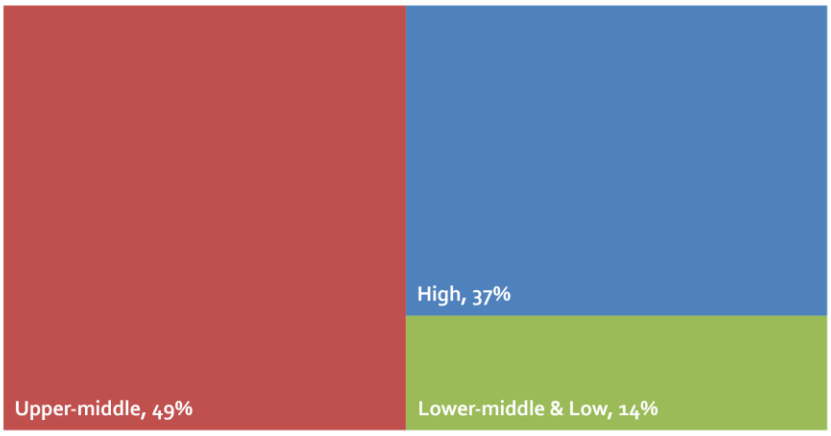


Source: Authors' elaboration based on World Bank regions.
Note: This figure includes 173 relevant papers that have an explicit geographical focus in their analysis (including those not coded because of quality or country oversampling).

In figure 3, we illustrate the distribution of countries' income levels that are the focus of study within the academic literature on industrial policy following the World Bank categories,[39] based on gross national income (GNI) per capita. Our findings suggest that the academic literature on industrial policy largely focuses on High and Upper-middle income countries, as these categories account for 86% of the corpus in our study. Interestingly, most of these documents are concerned with Upper-middle countries (representing 49% of the entire corpus). Conversely, the Lower-middle- and Low-income countries account for the remaining 14% of the corpus, indicating significantly less attention in the academic literature.

[37] The geographical scope refers to countries or regions that a particular paper examines (if any), and not to the institutional affiliation of the authors.
[38] Here, we follow the World Bank geographic regions to group countries into regions and add an additional group (None/Multi-region).
[39] See online documentation for further details: https://datahelpdesk.worldbank.org/knowledgebase/articles/378834-how-does-the-world-bank-classify-countries.

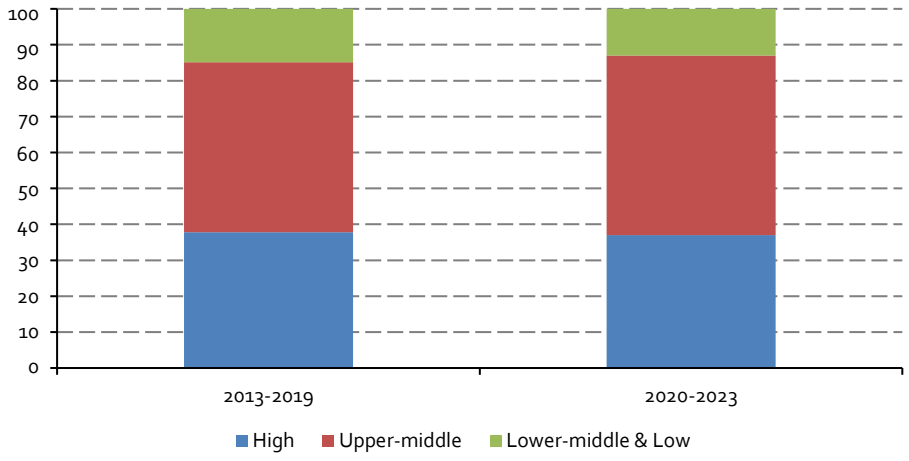
Figure 3
Share of industrial policy literature by income groups
(Percentages)



Source: Authors' elaboration based on World Bank income groups.
Note: This figure includes 173 relevant papers that have an explicit geographical focus in their analysis (including those not coded because of quality or country oversampling).

In figure 4 we further analyse the focus of the literature in terms of countries income group before and after the pandemic, with the results showing that there has been little to no change in the focus of the literature by income level prior to and post pandemic. The literature concerned with Upper-middle income countries exhibits a modest increase and continues to dominate both pre- and post-pandemic periods, accounting for 47% in the years 2013-2019 and 50% in the years 2020-2023. Concurrently, the share of publications dedicated to *High* and *Lower-middle and Low* income countries drops minimally from 38% to 37% and from 14% to 13%, respectively.

Figure 4
Share of industrial policy publications by income groups, before and after the pandemic, 2013-2019 and 2020-2022
(Percentages)



Source: Authors' elaboration based on World Bank income groups.
Note: This figure includes 173 relevant papers that have an explicit geographical focus in their analysis (including those not coded because of quality or country oversampling).

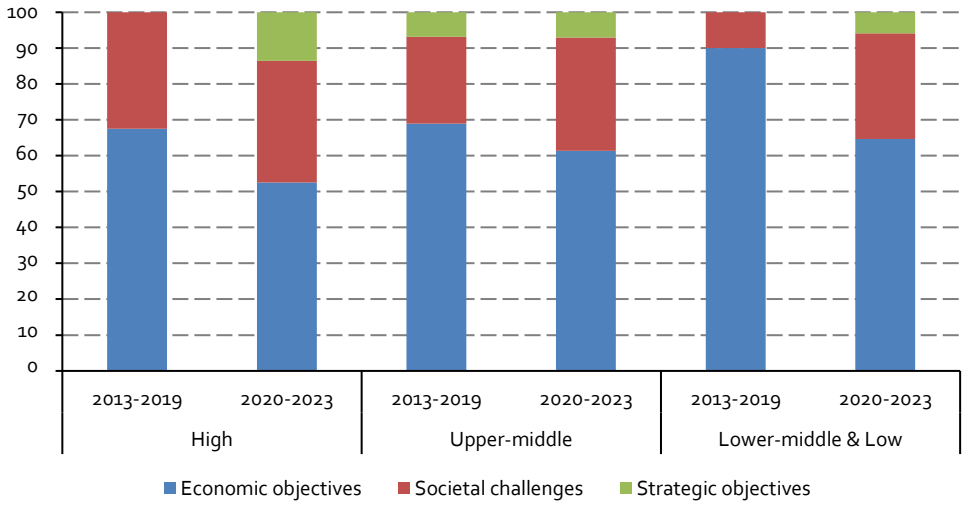
Overall, we observe that countries with relatively higher levels of income dominate the literature on industrial policy, with the recent literature both pre- and post-pandemic focusing disproportionately on *Upper-middle* income countries over the *High* income group. Moreover, while the share of the literature concerned with the *High* income groups remains high, the focus on *Lower-middle and Low* income countries remains rather scant before and after the pandemic. We now move to examine the evolution of the literature in terms of objectives, rationales, and instruments.

1. Trends in policy objectives

As explained in the Methods section (III.A), our coding scheme distinguishes three main categories of policy objectives: *economic*, *societal challenges*, and *strategic*. In our systematic review of the literature, we take note of the presence of these objectives by tagging the publications where any of these objectives are explicitly mentioned. In the case of economic objectives, we group together traditional aims of industrial policy such as economic growth, productivity, innovation, employment, and competitiveness. In the case of societal challenges, we capture a range of objectives that are broader in nature such as sustainability, inclusiveness in terms of regions or disadvantaged social groups, and the shaping of, adapting to, and coping with technological changes such as digitalization and/or automation. Lastly, in the strategic objectives we group a variety of aims that relate to national interests, such as technological and input autonomy, resilience, international influence, or security.

Figure 5 show how the presence of these objectives changed before and after the pandemic by income groups.

Figure 5
Objectives by income groups, before and after the pandemic, 2013-2023
(Percentages)



Source: Authors' elaboration based on World Bank income groups.
Note: This figure includes the 169 fully coded papers.

(a) High income group

In the pre-pandemic period (2013-2019), we find that industrial policies focusing exclusively on *economic objectives* represent the large majority, accounting for approximately 68% of the documents within this period. The economic objectives refer mainly to productivity, innovation, and economic growth, and in few cases also to competitiveness and employment. *Societal challenges* were mentioned in approximately 32% of the documents, especially sustainability and inclusion in the form of reducing

regional disparities. It is worth noting that while references to green growth and transitioning to a low-carbon economy began to emerge at least since the 1990s (Mastini et al., 2021), with regional development and 'left-behind places' also mentioned earlier in the 20th century (Sunley et al., 2021), neither of these social challenges were as prominent in the mainstream industrial policy academic discussion as they seem in more recent years.

In the post-pandemic period (2020-2023), we find that the share of industrial policy publications with an exclusive focus on *economic objectives* is reduced noticeably to just above 50%. In contrast, the presence of *societal challenges* in the industrial policy academic literature is quite stable (about a third of the cases), with sustainability and regional inclusion still the most common goals. In a few cases, the digitalization challenge emerges. Moreover, we see the emergence of *strategic objectives* in more than 10% of the studies during this recent period. Here, the main issues discussed are sovereignty, strategic autonomy (e.g., supply of critical inputs and infrastructure), and labour market resilience (e.g., re-skilling).

(b) Upper-middle income group

In the case of upper-middle income countries, during 2013-2019, industrial policy primarily emphasized *economic objectives*, accounting for about 69% of the documents. The economic goals range from innovation and productivity, to employment, competitiveness, and economic growth. *Societal challenges* are slightly less covered (24%) than in high income countries. Interestingly, in about 7% of the studies, *strategic objectives* were already mentioned in the pre-pandemic period, mainly related to resilience, such as protecting domestic production against external shocks in the case of Brazil (Santarcangelo et al., 2018).

Differently to high income countries, in the post-pandemic period the predominance of economic objectives reduces only weakly (to 61%). In other words, *economic objectives* remain at the core of industrial policy studies also in the most recent period. At the same time, we find that the focus on *societal challenges* increases to 32% of cases, while the share of documents mentioning *strategic objectives* remains roughly constant (around 7%). In the case of middle-income countries, the surge in *social challenges* in the post-pandemic period is centred on environmental sustainability, particularly the need to decarbonize energy production.

(c) Lower-middle and low income group

During the pre-pandemic years, the lower-middle and low-income countries show the highest predominance of *economic objectives*, reaching 90% of the studies, mainly concerned with promoting economic growth and building competitiveness. As a reminder, these are documents published in any country of the world but focusing on low-income countries. Only 10% of the studies discuss industrial policies in relation to *social challenges* – in particular, environmental sustainability. Furthermore, there is no mention of *strategic objectives* during this period.

In the post-pandemic period, the focus on *economic objectives* is still predominant (65%), but there is a notable increase in the importance of *social challenges* (29%), especially environmental sustainability, making the distribution like that in higher income countries. Moreover, there is an incipient presence of *strategic objectives* aligned with the sustainability challenges that, for instance, are framed as 'self-sufficiency' in green technologies in the case of India (Shrimali et al., 2023).

In summary, figure 5 illustrates a decrease in the predominance of *economic objectives*, while *societal challenges* and to a lesser extent *strategic objectives* also have attention during the 2020-2023 period. The former especially in higher income countries, the latter in lower income countries where the coverage was small in the pre-pandemic period. It is also important to note that the strategic challenges differ, with lower income countries concerned with technological independence and higher income countries concerned about security-related autonomy.

2. Trends in rationales

We distinguish five types of rationales: Structural Transformation; Creation of the conditions for (and the means of) production; Directing technological change; Creation of framework conditions; and Coordination and managing complexity. Here, we discuss whether and how the reference to these rationales (more or less explicitly) has changed before and after the pandemic across the different country income groups (figure 6).

(a) High income group

We find that during the pre-pandemic period the predominant rationale for industrial policy in high-income countries was the *Creation of the conditions for (and the means of) production*, accounting for 36% of the documents within this group. *Creation of framework conditions* and *Coordination and managing complexity* follow, accounting for 25% and 23% of the documents respectively. Taken together, these rationales point to the pivotal role that the government is considered to play, not only in providing infrastructure, enhancing factors of production, creating production activities or demand for firms (due to market failures), but also more broadly in creating the institutions and rules to regulate different markets correcting coordination failures, and directly generating or enhancing interdependencies between different actors in the economy. In contrast, the *Structural Transformation* (11%) and *Directing technological change* (5%) rationales are less mentioned in documents referring to high income countries, suggesting that the more active role of government in fostering new sectors and decidedly investing in new economic activities was comparatively less emphasised prior to the pandemic.

Moving on to the post-pandemic period, we observe a slight shift in the relative importance of these rationales. Although the *Creation of the conditions for (and the means of) production* remained the most prominent, we find a slight decrease in relevance (29%). Similarly, less relevant are *Coordination and managing complexity* (21%) and *Creation of framework conditions* (20%) rationales. These changes are accompanied by a moderate increase in the emphasis on *Structural Transformation* (16%) and a more marked increase in the importance of *Directing technological change* (13%). As an illustration of this trend, Pianta et al. (2020) suggest that industrial policy is required to set the direction of technological development toward the creation and diffusion of new clean technologies, creating new market opportunities, and fostering the green transition.

(b) Upper-middle-income group

In the Upper-middle-income group during the pre-pandemic period, *Creating the conditions for (and the means of) production* was also the most frequently mentioned rationale (40%). This was followed by the *Creation of framework conditions* (23%), emphasising the significance of supporting the enabling environments in emerging economies. Interestingly, the *Structural transformation* rationale was relatively more important than in the High-income group (23%), reflecting the need to drive a systemic transition towards high-growth, high-value added and frontier-technology production (Barbieri et al., 2021). We illustrate this point with the analysis of Malaysia and Thailand by Lee et al. (2021), who suggest that for the manufacturing industry to be in the technological frontier, a more decisive role for government to induce learning processes and accumulate capabilities of firms is needed. In contrast, rationales related to coordination failures and managing complexity (11%) and directing technological change (4%) received relatively less attention in documents related to this group of countries during this period.

In the post-pandemic period, from 2020 to 2023, the rationales remained consistent in terms of their relative importance. The primary justification for industrial policy remained *Creating the conditions for (and the means of) production* (32%), albeit with a moderation in its prominence. Similarly, *Creation of framework conditions* (23%) and *Structural Transformation* (21%) remained largely unchanged in terms of importance. The only moderate shift is the increased importance of *Directing technological change* (11%). Overall, the trend is similar to the high-income group.

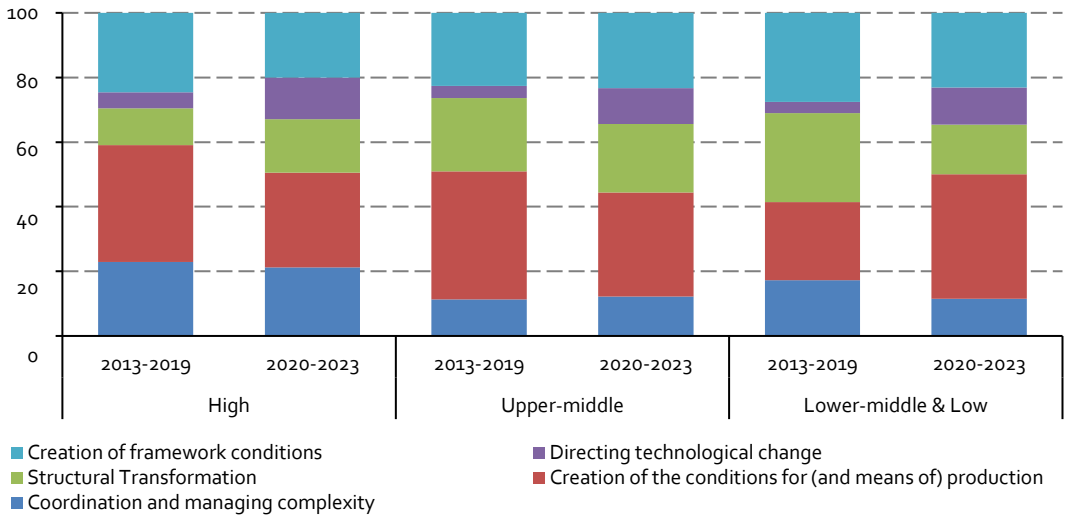
(c) Lower-middle and low-income group

In the pre-pandemic period, we observe that the relative importance of different rationales within the Lower-middle and Low-income group are different from countries with higher income. Namely, the *Creation of framework conditions* and *Structural Transformation* represent about 28% each, followed by the *Creation of means of (and the means of) production* (24%), and *Coordination and managing complexity* (17%). There is almost no reference in documents on these countries to *Directing technological change* (3%).

Moving to the post-pandemic period, the share of documents referring to the *Creation of framework conditions* and *Coordination and managing complexity* remained relatively stable at 23% and 12% respectively. Instead, the *Creation of (and the means of) the conditions for production* experienced a notable increase to 38%, mainly due to a stronger focus on supporting production capabilities of firms. At the same time, the relative importance of *Structural transformation* declined substantially (15%) while the emphasis on *Directing technological change* exhibited a marked increase to 12%. It is worth noting that the increased importance of *Directing technological change* resembles the trend followed by the groups of countries with higher incomes. As an example, Jensen and Whitfield (2022) discusses the role of industrial policy in Ethiopia in promoting eco-efficiency for supplier firms in the apparel industry, where accessing and learning how to use equipment at the technological frontier as well as the role indigenous innovations in generating alternative raw materials is crucial to meet environmental standards.

In sum, as shown in figure 6, the evolving rationales underlying industrial policy within different income groups show a shift toward a more comprehensive and balanced approach in the 2020-2023 period. This shift in rationales, though, is related to different variations in policy emphasis across income groups. High-income countries continued to prioritise coordination and conditions for production but increased their focus on directing technological change. Upper-middle-income countries maintained a strong focus on creating production conditions, and together with the Lower-middle & low-income countries intensified efforts in this regard and in directing technological change. Structural transformation, while relevant across income groups particularly in countries with lower levels of income, showed mixed trends. These shifts likely reflect different economic challenges and development stages.

Figure 6
Rationales by income groups, before and after the pandemic, 2013-2023
(Percentages)



Source: Authors' elaboration based on World Bank income groups.
Note: This figure includes the 169 fully coded papers.

3. Implementation: trends regarding instruments

The systematic reading of the recent academic literature allows us to review a wide array of policy instruments found in the literature, ranging from subsidies and tax incentives to regulatory reforms, education, skills development, and infrastructure investments, among others. It is worth noting that the literature exhibits significant heterogeneity in how these instruments are described and detailed. Often, instruments are mentioned as components of the broader institutional landscape within which firms or industries operate, lacking in-depth characterization. To address these challenges, we have adopted an inductive and qualitative approach. We selectively focus on examples. This approach allows us to gain a deeper understanding of the intricate interactions between objectives, rationales, and design features across countries of diverse income groups.

We examined the design features of policy instruments of three countries, one from each income group: United Kingdom (High-income), South Africa (Upper-middle income), and Ethiopia (Low-income group). For each case, we selected relevant industrial policy instruments before and after the pandemic, and identified their rationales and objectives, as described in the literature. This exercise allows us to illustrate the evolving discussion of industrial policy in specific contexts and its connections with policy implementation.

The three cases provide insights into the evolving nature of industrial policy instruments in response to changing circumstances and objectives and how they are framed by the academic literature in terms of rationales. First, in the case of United Kingdom (a high-income country), we compare the Catapult centres to the High-Speed Rail Network to reflect on the shift from innovation-driven policies to infrastructure and social challenge objectives. Second, in the case of South Africa (an upper-middle-income country) we discuss the Renewable Energy Independent Power Producer Procurement Program as an example of pre-pandemic industrial policy, and the subsequent discussion of the Digital skills and ICT infrastructure development plan. This highlights the importance of creating specific technological capabilities as part of the post-pandemic context. Finally, the third case is Ethiopia (a low-income country), and we discuss the shift in emphasis from Special Economic Zones to Eco-Industrial Park Development, aligning the policy instrument related to infrastructures and structural transformations with a broader set of objectives such as sustainability and green industrial practices. These cases collectively demonstrate the dynamic nature of industrial policy and the interplay between objectives, rationales, and policy instruments in the classification proposed in Table 4. It is worth mentioning that we are not aiming at an assessment of the changes in industrial policies in terms of effectiveness. Our conclusions are based purely on the how changes in policy objectives may also need changes in the rationales to justify the public intervention, and how both of these shape the design of the instruments.

Case 1: United Kingdom

The United Kingdom's implementation of the Catapult Centres (pre-pandemic) is considered a key industrial policy instrument in the pre-pandemic period. Following Bailey and Tomlinson (2017), we identify productivity and innovation as the core *economic objectives* of this instrument (Table 10). According to the description and type of intervention, the Catapult approach was driven by two main rationales: the need to address coordination failures in the innovation ecosystem and to create favourable conditions for production in selected sectors.[40] Namely, these Catapult Centres acted as intermediaries to bridge the gap between early stage publicly funded basic research and privately funded research, particularly during the commercialisation phase. They were designed to play a pivotal role in facilitating networking among regional clusters, research institutions, and higher education bodies, thereby enhancing knowledge transfer and learning. Each Catapult Centre operates as an independent legal entity with industry-experienced leadership and a board composed of experts in

[40] Based on https://catapult.org.uk/about-us/why-the-catapult-network/.

respective technological domains. By 2013 there were 11 Catapult centres in the following areas: Cell and Gene Therapy, Compound Semiconductor Applications, Digital, Energy Systems, Future Cities, High Value Manufacturing, Medicines Discovery, Offshore Renewable Energy, Precision Medicine, Satellite Applications and Transport Systems. As of today, the Catapult Network is formed by 9 centres that work together with a range of business actors.

In the years after the pandemic, one key intervention in the United Kingdom was the development of the High-Speed Rail Network (HS2), an industrial policy instrument with a marked emphasis on regional development in the context of the 'Levelling-up Agenda' (Coffey et al., 2022). This initiative combines traditional *economic objectives* such as enhancing productivity and fostering economic growth with specific challenges related to inequality: regional disparities, promoting social inclusiveness, and access to sustainable transport. The instrument's rationale revolved around the need to improve the conditions for production and infrastructures: a comprehensive infrastructure program intended to leverage on London's agglomeration effects around the financial and knowledge-based service sector to extend its spillovers to other regions, particularly the Midlands and the North. HS2 design features consist of investment in trains powered by zero-carbon energy and involved contracting companies from across the UK, creating jobs and additional rail capacity to facilitate commuting, promote regional mobility, and increased freight services in under-served communities.[41]

Table 11
United Kingdom: rationales and objectives of two concrete instruments implemented before and after the pandemic

Rationales		Structural Transformation	Creation of conditions for (and means of) production	Directing technological change	Creation of framework conditions	Coordination and managing complexity
Objectives						
Economic Objectives	Productivity		Catapult Centres High Speed Rail Network (HS2)		High Speed Rail Network (HS2)	Catapult Centres
	Innovation		Catapult Centres			
	Economic growth		High Speed Rail Network (HS2)		High Speed Rail Network (HS2)	
Social Challenges	Social Inclusiveness		High Speed Rail Network (HS2)		High Speed Rail Network (HS2)	
	Regional disparities					
	Environmental sustainability					
Strategic Objectives						

Source: Authors' elaboration based on the literature.
Note: Catapult Centres (pre-pandemic): *Rationale*: address the gap between early stage publicly funded basic research and privately funded research at the commercialisation stage; facilitate networking among actors in regional clusters and, research and higher education bodies to enhance 'learning' and 'knowledge transfer'; *Design*: Each Catapult centre is an independent legal entity, limited by guarantee, and is led by a Chief Executive Officer from industry with a Board composed of business users and experts in the respective technological domain.
High Speed Rail Network (HS2) (post-pandemic): *Rationale*: Infrastructure program that aims to leverage London's agglomeration effects relevant to the financial and knowledge-based services with other parts of Britain (the Midlands and the North); *Design*: Trains powered by zero carbon energy built by contracting companies across the UK, creating more rail capacity to serve commuters, and provide regional and freight services.

[41] Based on https://www.hs2.org.uk/.

The comparison between Catapult Centres and the HS2 project in the UK reflects different policy objectives and rationales underpinning the two different interventions (Table 10). We see the Catapult Centres as a typical example of industrial policy, with aims on innovation and productivity, and a rationale that focuses on addressing coordination failures in the innovation ecosystem. In contrast, the HS2 infrastructure initiative in the post-pandemic years is linked to a broader set of objectives, including regional development, social inclusiveness, and sustainability. This shift seems to suggest a response to the challenges posed by the pandemic, emphasising infrastructure development and regional integration to stimulate economic recovery and reduce regional disparities. However, in terms of its underpinning rationales, the instrument is motivated by traditional concerns over enabling conditions and leveraging agglomeration economies, without, for instance, supporting a more decided sectoral transformation of regional economies.

Case 2: South Africa

In the period prior to the pandemic, an interesting instrument implemented in South Africa was the Renewable Energy Independent Power Producer Procurement Program (REIPPPP). The instrument addressed both economic objectives and social challenges, including enhancing competitiveness, employment, sustainability, and the inclusion of disadvantaged groups in the formal economy (Table 11).

Table 12
South Africa: rationales and objectives of two concrete instruments implemented before and after the pandemic

Rationales		Structural Transformation	Creation of conditions for (and means of) production	Directing technological change	Creation of framework conditions	Coordination and managing complexity
Objectives						
Economic Objectives	Competitiveness	REIPPPP	REIPPPP DS&ICT		REIPPPP DS&ICT	
	Employment		REIPPPP		REIPPPP	
	Productivity		DS&ICT		DS&ICT	
Social Challenges	Sustainability	REIPPPP	REIPPPP		REIPPPP	
	Social inclusion					
	Digitisation		DS&ICT		DS&ICT	
Strategic Objectives						

Source: Authors' elaboration based on the literature and policy documents.
Note: Renewable Energy Independent Power Producer Procurement Program (2011) (REIPPPP) (Pre-pandemic): Rationale: Market-based intervention where Govt. set out how long-term electricity demands would be met, inducing a change from fossil fuel-based generation toward solar PV and wind generation; Design: competitive auctioning mechanism that is technology-specific (renewable energy production) with several regulatory requirements incl. minimum local content requirements (% of local suppliers), community ownership, ethnic quotas (shareholding, jobs for black citizens).
Digital Skills Policy and ICT Infrastructure (DS&ICT) (Post-pandemic): Rationale: production conditions are very difficult (and costly) to meet in firms operating in countries with limited access to high-quality electricity supply and connectivity; Design: The reform of incentives and organizational structures within technical and vocational education and training institutions to incentivize firm-driven training and therefore develop sector specific digital skills.

Specifically, this initiative aimed to induce a shift from fossil fuel-based electricity generation toward solar photovoltaic (PV) and wind generation through an auctioning mechanism. In simple terms, companies submit proposals to build and operate renewable energy facilities, and the successful bidders are awarded long-term contracts with the government to sell the electricity to the national power utility at fixed prices. The program's design featured a competitive auctioning mechanism that was technology-specific, focusing on renewable energy production. It included several regulatory requirements, such as minimum local content requirements (as a percentage of local suppliers), community ownership participation, and ethnic quotas for shareholding and job opportunities for black citizens (Matsuo et al., 2019).

Regarding the rationale, as discussed by Matsuo et al. (2019), REIPPPP was grounded in a market-based intervention strategy, creating demand for firms to enter a market for which there was no demand (without the government intervention). Aligned with the climate objective of reducing carbon dioxide emissions, the government pushed for the entry of new producers of renewable energy into the highly concentrated and coal-dominated energy sector. We identify *structural transformation* as rationale given that the existing energy mix relied mainly on fossil-fuels and the interventions have an explicit orientation toward expanding renewables through the promotion of domestic capabilities (e.g., via local content requirements). There is also a link to the *creation of conditions for (and means of) production* in the sense that the government is directly demanding renewable energy, thus creating the market for new producers. Finally, there is also the presence of *creation of framework conditions*, actively defining the rules and incentives for private companies to compete, invest in and operate the renewable energy projects, indicating ownership structures and participation of specific social groups.

In the post-pandemic landscape, the literature has emphasised the need for South Africa to transition toward a digital-focused industrial policy. Consequently, the primary objectives of IP included enhancing *economic* productivity and competitiveness, driven by digitalisation. This also came with the aim to address the social challenges of digitisation. The rationale behind this shift was the recognition that firms operating in countries with limited access to high-quality electricity supply and connectivity face significant challenges and costs in meeting production conditions (Andreoni et al., 2021). Here, the authors discuss a policy approach centred on digital skills development and information and communication technology (ICT) infrastructure. Such a policy reform encompasses incentives and organisational changes within technical and vocational education and training institutions. In turn, these changes would incentivise firm-driven training initiatives, specifically targeting the development of sector-specific digital skills. That is, the main rationales are related to creating the condition for firms to produce, including the factors of production (e.g., skilled workers), and to some extent creating the market regulations.

Arguably, the differences between REIPPPP and the Digital Skills Policy and ICT Infrastructure illustrate the mixed responses to changing economic and societal needs exacerbated by the pandemic. At the same time, it is evident that the different policy instruments do not necessarily entail comprehensive interventions in terms of objectives and rationales. The pre-pandemic example, REIPPPP was already quite comprehensive in terms of rationales and objectives, as it emphasized sustainability and inclusiveness in the renewable energy sector. In contrast, the post-pandemic policy prioritises economic productivity and competitiveness through digitalisation. This shift aligns with the recognition of the critical role of digital skills and infrastructure and the increased importance of directing technical change as a rationale that gained attention in the literature, while in terms of objectives the connection with other challenges such as sustainability is not emphasized.

Case 3: Ethiopia

One of the most prominent instruments in Ethiopia's pre-pandemic industrial policy was the establishment of Special Economic Zones (SEZs) (Table 12). These zones aimed to achieve various *economic objectives*, including enhancing competitiveness, employment, and economic growth (Oqubay, 2019). As discussed by Hager et al. (2019), the rationale behind SEZs was the need to transform the economy towards manufacturing (particularly in light manufacturing sectors such as leather and garment production), providing firms with infrastructure facilities and foreign demand to stimulate such investments. The strategy involved attracting Foreign Direct Investment (FDI) and inducing technology transfer to upgrade local firms. In terms of design, the SEZs involved an ad-hoc commission regulating these zones, with the government playing the roles of developer, manager, and landbank for maintaining and allocating land for SEZ development (Kumera and Woldetensae, 2023; Hager et al., 2019).

Table 13
Ethiopia: rationales and objectives of two concrete instruments implemented before and after the pandemic

Rationales		Structural Transformation	Creation of conditions for (and means of) efficient production	Directing technological change	Creation of framework conditions	Coordination and managing complexity
Objectives						
Economic Objectives	Competitiveness	SEZ Eco-Industrial Park	SEZ Eco-Industrial Park			SEZ Eco-Industrial Park
	Employment	SEZ	SEZ			SEZ
	Economic growth	SEZ Eco-Industrial Park	SEZ Eco-Industrial Park			SEZ Eco-Industrial Park
	Innovation	Eco-Industrial Park	Eco-Industrial Park			Eco-Industrial Park
Social Challenges	Sustainability	Eco-Industrial Park	Eco-Industrial Park			Eco-Industrial Park
Strategic Objectives						

Source: Authors' elaboration based on the literature and policy documents.
Note: Special Economic Zones (SEZ) (pre-pandemic): *Rationale:* SEZ are set to contribute to structural transformation (light manufacturing, in particular leather and garment) by attracting FDI and inducing tech. transfer to upgrade local firms; *Design:* SEZs are regulated an ad-hoc commission, and the Government acts as developer, manager, and landbank for maintaining and allocating the land that can be transferred for the development of SEZs. There are two types: public zones and zones established by private capital. By 2017, a total of five zones were operational and exporting (Hager et al., 2019).
Eco-Industrial Park Development (post-pandemic): *Rationale*: Create green industrial production, coordinate collective investments, and subsidize investments with positive externalities. Specific focus on creating markets for environmental services; *Design:* Apparel-specific parks that meet international standards including energy sources from renewables, waste management, recycling facilities, sustainable infrastructure.

Regarding rationales, SEZs are linked to the *creation of conditions for (and means of) production*, whereby foreign investments are key levers to finance and build the infrastructure necessary for exporting including transportation and telecommunications. Moreover, the presence of foreign firms (often large multinationals) is also seen as a vehicle to upgrade the domestic private sector through knowledge and technology spillovers (e.g., the introduction of cutting-edge machinery, etc.), while generating demand for business services and local suppliers (e.g., logistics), thus catalysing *structural transformation* in the productive structure. Finally, SEZs are also linked to *coordination and managing complexity*, insofar as they require nurturing public-private linkages to align on strategic aspects of the SEZs such as the definition of a strategic location and the state-induced interactions between local and foreign firms (Haget et al., 2019; Tager, 2023).

In the post-pandemic landscape, Ethiopia's SEZs have moved towards Eco-Industrial Park Developments. This policy instrument expanded in terms of objectives, including not only *economic objectives* such as innovation, competitiveness, and economic growth, but also *social challenges* such as sustainability as an integral component of the intervention. The justification for public intervention lies in the absence of demand for producing and using sustainable energy, on incentives to use mitigation technologies to promote green industrial production environments, on the need to coordinate collective investments, and of subsidising investments with positive externalities (Jensen and Whitfield, 2022). Notably, the policy contemplates establishing markets for environmental services such as (green) waste management.

Ethiopia's tilt from Special Economic Zones to Eco-Industrial Park Development underscores that the change of industrial policy objectives might also mean an expansion of the rationales to justify the public intervention. Namely, the pre-pandemic emphasis on attracting FDI and technology transfer in the manufacturing sector moves toward sustainable industrial development by focusing on green practices and environmental services that entail the generation of indigenous capabilities in new technologies.

The impetus behind the promotion of Eco-Industrial Parks, as discussed by Jensen and Whitfield (2022), was primarily promoted by industries with significant environmental impacts, such as the apparel sector. This drive aligned with the interests of international industry leaders. Specifically, it was oriented towards aligning with the sustainability goals of major players like PVH – a major apparel buyer that is also a member of the Sustainable Apparel Coalition and actively contributes to setting global industry standards. These standards encompass air pollution, the use of natural resources, verification processes, and capacity-building measures for suppliers. Accordingly, Eco-Parks feature renewable energy sources, advanced waste management systems, recycling facilities, and sustainable infrastructure.

IV. Discussion

A. Two main shifts in industrial policy thinking

Social challenges —such as those related to sustainable development (from poverty and inequality to climate change)— and strategic objectives —such as those related to security— are not new. Nor are industrial polices. The extension of industrial policy objectives to embrace broader social challenges – especially in lower income countries, where the focus was traditionally on economic objectives – and strategic objectives —due to international crises— is more recent. From the academic and policy literature reviewed, this extension seems to have been amplified by the Covid-19 pandemic, which has exposed weaknesses in many countries that go beyond economic productivity and competition – such as the climate emergency or growing within country divides leading to political tensions. But the discussion on social challenges related to industrial strategies was already thriving before, especially in the academic literature. The role of security objectives underpinning industrial policies is also not new, as witnessed by the R&D expenditure in the military sector.

The increased focus on social challenges and strategic objectives raises the question of the extent to which this broader focus leads to trade-offs to consider or whether synergies exist. As discussed by Porcile et al. (2023), there are few endogenous forces that encourage sustainable development, creating a role for policy and for politics and political negotiations. In this sense, it is unsurprising that the scope of industrial policy has broadened to consider these challenges. The work of Porcile et al. (2023) further shows that encouraging economic development through technological progress, for example, presents risks for sustainable development, potentially leading to a growth rate that is too high to be consistent with meeting climate commitments. The risk of a trade-off between economic and social considerations in driving industrial policy thus exists. At the same time, if policy is further directed to increase the absorptive capacity in green technologies or to change the structure of production and demand, and social norms, then this trade-off may cease, and opportunities exist for higher growth alongside meeting climate commitments. Given the impetus for policies to mitigate climate change, and the imposition by developed countries of climate policies that impact third countries (e.g., the EU's Carbon

Border Adjustment Mechanism), it is increasingly difficult to develop an industrial strategy without considering this social challenge. Similar arguments can be made regarding aspects of strategic autonomy (e.g., in the context of critical minerals), while issues of inclusiveness perhaps remain more driven by internal sentiments. As such, it is likely that a more holistic approach to the objectives of industrial will be increasingly adopted, including in countries at lower levels of development.

Arguably, based on our review of the academic literature and examples of the policy literature, this extension of industrial policy to social and strategic objectives seems to be a privilege, or a responsibility, of high-income countries. In contrast, lower income countries appear more concerned about prioritising catching up in terms of technological capabilities and competitiveness with higher income countries. This does not mean that social challenges are neglected in the academic and policy discussion in lower income countries. Where the two groups of countries differ more markedly is in addressing strategic objectives, driven more by the current geopolitical tensions than by the pandemic. Unlike the social objectives, the emphasis on strategic objectives is probably more driven by the policy discourse than by the academic literature.

The second important shift in both policy and academic thinking is moving from industrial policies to strategies (Criscuolo et al, 2022; Juhász et al, 2023). That is, from relatively specific interventions (such as Export Processing Zones, smart specialisation, or technology/sector strategies) to more coordinated policy mixes. Again, this more systematic/strategic approach is not new – it has been present, for instance, in the EU and UK industrial strategies, it is not used everywhere (as it can be noted, for example, in the case of the United States), and when it is used it is not clear whether the synergies and tensions between different objectives and instruments have been adequately factored in, or if the strategy reflects a mixed bag of short term objectives as in the UK (Ciarli et al, 2024).

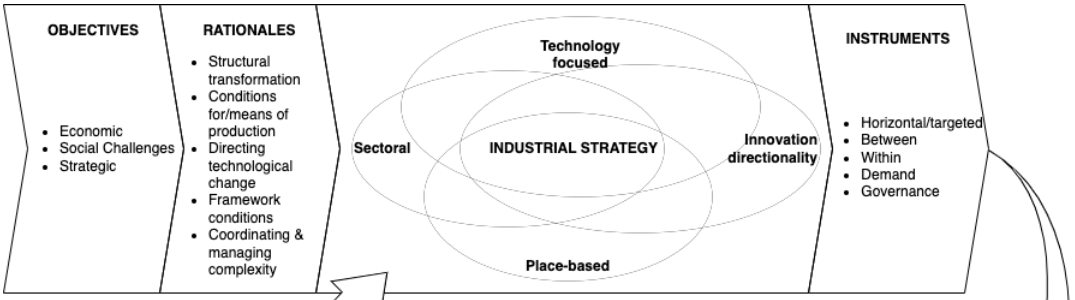
B. A revised industrial policy framework

Taken together, the two shifts discussed in section o call for a framework to design industrial strategies that puts more emphasis on the synergies and tensions between different objectives (and related instruments), and the rationales that command public interventions. On the one hand, including social challenges as part of the objectives increases the interactions between objectives and, therefore, the complexity of the problem. On the other hand, the design of industrial strategies is one way to put several stakeholders around a table to consider alternative scenarios that maximise the synergies and minimise the tensions between their different objectives.

Carefully thinking about the rationales for the industrial strategy —a combination of public interventions using a combination of instruments— is essential. Institutions are needed to coordinate the different —and diverging— objectives of industrial strategies. More important is to frame which decisions cannot be left to firms alone. Questions about directions of technical change, and the complex relations between different economic, strategic, and social objectives, for example, point to the need for some form of coordination and institutional fabric. Part of the rationale for directing technical change is the need to recognise the diverse priorities for investing in innovation inputs (e.g., technologies) leading to outputs that have several, often unknown, impacts (Rodrik, 2022). For instance, the question about how emerging technology such as AI will affect jobs is a question about education policies, but also a question about what technology we may want to invest in (Autor, 2022). Questions about managing complexity, to highlight another example, point to the need to understand the complex implications of different advances in technology that can spur productivity. While it is not possible to predict technological and societal transformation, it is possible to integrate in the policy formulation the views of different stakeholders that contribute to or are affected by these changes (Ciarli, 2022).

This leads us to a slightly modified framework for industrial strategies with respect to the one proposed by Criscuolo et al. (2022) and to which we refer the reader to for details about the classification of instruments and industrial strategies. This modified framework: (i) places more emphasis on the rationales for public interventions to guide the design of the strategy and the choice and design of the instruments; (ii) combines different strategies that are likely to influence each other (sectoral, technology focused, place-based, and directing innovation); and (iii) considers the complex synergies and tensions between objectives and rationales discussed earlier in this section (see diagram 2).

Diagram 2
Formulation of industrial strategies for different rationales



			Rationales				
			Structural transformation	Conditions for/means of production	Directing technological change	Framework conditions	Coordinating and managing complexity
Objectives	Economic objectives	*Examples* - Productivity - Innovation - Employment - …					
	Social Challenges	*Examples* - Inequality - Climate change - Digitisation - …					
	Strategic objectives	*Examples* - Resilience - Strategic autonomy - Planning - …					

Source: Authors' elaboration based on Criscuolo et al. (2022).
Note: For a detailed discussion of objectives and rationales, please refer to section I. For an explanation of the classification of industrial strategies and instruments, please refer to Criscuolo et al. (2022).

In practice, in the first step policy makers may need to identify the objectives following a thorough consultation with different stakeholders with diverse and diverging priorities. In the second step, policy makers need to identity the areas in which a public intervention is needed. For instance, with reference to a standard market failure, because firms have no incentives to invest in industries for which there is no skilled labour. Or, with reference to a less standard market failure, to improve the economic and social opportunities for individuals from marginalised groups in society to contribute to innovation activities. Both objectives and rationales are likely to depend on a country's diverse priorities, but also on other countries' industrial strategies and how they can affect them (e.g., through reduced demand for strategic goods). For instance, the increased focus on strategic autonomy in higher income countries is likely to reduce the demand for goods exported by emerging and lower income countries. This may require a response in lower income countries to consider their role and integration in global value chains.

Third, based on a careful analysis of the synergies and tensions between different objectives and rationales for public interventions, policy makers can design an industrial strategy that balances them. This includes the selection of specific instruments to address the interaction between objectives and rationales included in the formulation of the industrial strategy (see matrix in diagram 2).

From our review, although limited, the discussion of the rationales for industrial policy seems to be more articulated in the academic literature than it is in the policy domains —especially the country documents— where rationales are often considered as objectives. In both corpora, there is some discussion about directing technical change, and coordinating complex interactions – beyond creating the conditions for production, including framework conditions, and structural transformation. But this is limited in the policy discourse. Where the policy discourse seems to move within the academic literature is in recognising the need to design coordinated industrial policies that consider the impacts on several objectives, though this seems to be more the case in the European continent than elsewhere.

The academic literature and the policy discourse also coincide in relation to the extent and direction of implementation. While it is not in the scope of this document to establish a causal relation, we notice an increase (revival) in the academic discussion on industrial policies, and in the number and funding of industrial strategies across countries.

However, high-income countries are in a privileged position here, being more present both in the academic discussion and in investing more in industrial policies. This trend may call the attention of policy makers in middle- and lower-income countries. With the main objectives of higher income being economic and technological competition, and with an additional objective being strategic autonomy, there is a risk that such intervention may increase the wedge between higher and lower income countries. In terms of implementation, both the academic and the policy literature seem to point to coordinated strategies.

C. Considerations for Latin American countries

In relation to objectives, Latin American countries have longstanding challenges, in many cases unique to the region. These include the inclusion of the indigenous population in the formal economy, achieving full coverage of public utilities (e.g., water sanitation, internet access, etc.), and decent housing (i.e., not overcrowded, solid materials, sustainable, etc.). There is also the problem of climate change hitting more severely countries in the global south – e.g., islands threatened by rising sea levels in the Caribbean, extreme droughts in Chile, etc. Our survey of the literature suggests that the industrial strategies to be crafted by and for Latin American countries would need to incorporate their incumbent and foreseen societal/environmental challenges. High income countries are already taking steps to mitigate the impacts of climate change, with Latin American countries also needing to take these strategic objectives seriously. In considering such steps, it is important to keep in mind that efforts to societal/environmental challenges also represents an opportunity. This is most obvious in the context of environmental challenges, with an expectation that the shift to green energy, for example, will lead to the development and expansion of new industries. Issues like resilience and strategic autonomy have proven to be critical in times of crisis (e.g., dealing with pandemics and the lack of access to basic medical supplies and vaccines, wars that disrupt/alter demand for exports and therefore domestic economic conditions). Latin American countries should also seriously consider the consequences of strategic autonomy directions in higher income countries, which may lead to reducing or severing demand for some of the core outputs in Latin America, especially primary resources.

In relation to rationales, structural change is key, especially considering potential changes in world demand for critical primary resources. Based on the above framework, however, it is also important to elaborate on the other rationales in connection to the different objectives and how they

interact. Carefully considering directing technical change will be important to address both the economic objectives and the social challenges, including the high levels of inequality in the region, access to basic needs, sustainable transportation and infrastructures, and the impacts of climate change. This is in addition to the more traditional rationales related to improving the framework conditions and creating the conditions for and means of production. As discussed above, it is important to consider a holistic approach to industrial strategies in Latin American countries, which addresses the different rationales and balances among the different objectives, instead of silver bullets based on ambitious missions.

In relation to more specific interventions and implementation, our survey suggests that strategies setting in motion the productive sector (at large) seem to work when objectives and rationales are aligned. The strategies use a wide array of instruments and cover a range of policy domains. Considering the regional and country-specific objectives and relevant rationales, Latin American countries may need to open the industrial policy toolkit to more long term and comprehensive industrial strategies that also consider social challenges and strategic objectives. This may include fiscal, monetary, and (more traditional) micro/meso interventions. In other words, the design of a strategy may be more relevant than the choice of a specific working instrument. It may be more important to craft a coherent mix of policies rather than focusing on one specific policy considered more relevant by a particular political constituency. On this latter point, the notable distinction between high-income and other countries in their objectives for industrial policy may be demand-driven, but it may also involve supply-side factors such as the resources available for industrial policy and the capabilities of national administrations. In designing an appropriate industrial policy, these challenges of resources and capabilities need to be an important part of the discussion.

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Annexes

Annex 1
List of definitions of industrial policy

Table A1
List of definitions of industrial policy

Curzon Price, V., "Industrial Policies in the European Community", 1981	"Industrial policy may be generally defined as any government measure, or set of measures, to promote or prevent structural change."
Adams and Klein, "Industrial Policies for Growth and Competitiveness", Lexington Books, 1983	Industrial policy includes "everything which is useful to improve growth and competitive performance"
Jacquemin, A., Industrial Policies and the Community in Coffey, P., Nijhoff, M. (ed.), Main Economic Policy Areas of the EEC, 1983	Industrial policy "has to specify and solve the problems of structural change in the economy. Its task is to create optimum conditions for the necessary structural transformations to be carried out."
Tyson, L., Zysman, J., "American Industry in International Competition: Government Policies and Corporate Strategies", 1983	"Industrial policy ... means government policy aimed at or motivated by problems within specific sectors."
Johnson, Ch., "The Idea of Industrial Policy", in Johnson, Ch., "The Industrial Policy Debate", 1984	"Industrial policy means the initiation and co-ordination of governmental initiatives to leverage upward the productivity and competitiveness of the whole economy and of particular industries in it."
Graham, H., "European Industrial Policy", Croom Helm, London, 1986	"Industrial policies referrer to those policies intended to affect in some ways manufacturing or service industries."
Geroski, P.A., European Industrial Policy and Industrial Policy in Europe, Oxford Review of Economic Policy, Vol. 5, 1989	Industrial Policy is "wide-ranging, ill assorted collection of micro-based supply initiatives which are designed to improve market performance in a variety of occasionally mutually inconsistent ways."
Krugman, P., Obstfeld, M., "International Economics Theory and Policy", 1991	"Industrial policy is an attempt by a government to encourage resources to move into particular sectors that the government views as important to future economic growth."
Chang, H.-J., "The Political Economy of Industrial Policy", St Martins's Press, 1994	Industrial policy is one "aimed at particular industries (and firms as their components) to achieve the outcomes that are perceived by the state to be efficient for the economy as a whole."
Sharp, M., "What is Industrial Policy and Why is it Necessary?", Prepared for TSER project No PL97 1059 on Science, Technology and Broad Industrial Policy, May 1998	Narrow concept "Industrial policy is often restricted to policies about subsidies." Broad concept "(industrial policy) can be defined as any policy affecting the allocation of resources to industry and in this sense embraces both macro-economic policy ... as well as the more traditional areas of microeconomic policy."
Foreman-Peck, J., and Frederico, G., European Industrial Policy: The Twentieth-Century Experience, Oxford University Press, 1999	Industrial policy is "every form of state intervention that affects industry as a distinct part of the economy."
Beath, J., "UK Industrial Policy: Old Tunes on New Instruments?", Oxford Review of Economic Policy, Vol. 18 No.2, 2002	Narrow view: "Restrict attention to policies that target particular firms and industrial sectors." Broad view: "any policy that shapes or influences the competitiveness of a country's firms and industries"
Rodrik, D. (2004), Industrial Policy for the Twenty-First Century, CEPR Discussion Paper No. 4767, 2004	Uses the term industrial policy for "restructuring policies in favour of more dynamic activities generally, regardless of whether those are located within industry or manufacturing per se."
Aiginger, K., Sieber, S., Towards a renewed industrial policy in Europe, Background Report of the Competitiveness of European Manufacturing, WIFO	Industrial policy is the activity which creates a favourable environment for European business in general, the manufacturing sector and its industries in specific
(Pack and Saggi, 2006) p267-268	"any type of government intervention or policy that attempts to alter the structure of production in favor of sectors that are expected to offer better prospects for economic growth in a way that would not occur in the absence of such intervention in the market equilibrium"
(Pitelis, 2006)	"Industrial policy refers to a set of measures taken by a government and aiming at influencing a country's performance towards a desired objective."
Cimoli et al. (2009a, pp. 1-2)	any process affecting the economic and technological performance of an economy by "shaping the very nature of the economic actors, the market mechanisms and rules under which they operate, and the boundaries between what is governed by market transactions, and what is not."
(Warwick, 2013) p. 16	"*any type of intervention* or government policy that attempts *to improve the business environment* or to alter the structure of *economic activity* toward sectors, *technologies or tasks* that are expected to offer better prospects for economic growth *or societal welfare* than would occur in the absence of such intervention"
(Lee, 2013)	"it refers to policies that improve the structure of a domestic industry in order to enhance a country's international competitiveness"
(Schmitz et al., 2015)	"government intervention which brings about economic restructuring without overstretching the carrying capacity of the global ecosystem"

(Di Maio, 2014) p. 4	"set of government measures –targeted at specific industries or firms- aimed at supporting the development and upgrading of industrial output"
(Nassif et al., 2018)	"Industrial policy is defined as the combination of a set of governmental incentives at the sectoral level (tariff protection on imports, subsidies allowed by the World Trade Organization–WTO, long-term public credit for investment projects and innovation, among others) with horizontal policies (especially infrastructure, and research and development–R&D)"
(Lechevalier et al., 2019)	"We refer to a definition of industrial policies that encompasses all government interventions aiming at favoring growth which involves policies implemented in many fundamental institutional domains as education policies, research policy, legal framework protecting intellectual property rights"
(Oqubay, 2019)	"Industrial policy may be defined as 'a strategy that includes a range of implicit or explicit policy instruments selectively focused on specific industrial sectors for the purpose of structural change in line with a broader national vision and strategy'"
(Lane, 2020)	"intentional political action meant to shift the industrial structure of an economy. Often policymakers hope this shift will be more favorable for growth, relative to what would have happened had the economy evolved according to its static comparative advantage"
(Hauge, 2020)	"A policy that deliberately favours particular industries—or even firms—over others, against market signals, usually to enhance efficiency and to promote productivity growth for the targeted industries as well as for the whole economy."
(Zhang, 2020)	"IP is measures taken by government to aim at improving firm's competitiveness and promoting structural transformation"
(Ferrannini et al., 2021)	"industrial policy should be conceived both as a technical and political intervention to redesign our future societies, favouring and governing a structural transformation of the industry, the economy and the whole society. This implies primarily that industrial policy must be fundamentally tied to a value-based societal vision able to reconcile sustainability and development"
(Johnstone et al., 2021)	"structural policies designed to strengthen the efficiency, scale and international competitiveness of domestic industrial sectors, typically containing an element of national champions, of self-reliance in bringing about growth and development"
(Armstrong, 2021)	"government interventions aiming to stimulate specific economic activities and promote structural change"
(Zhao and Yuan, 2021)	"Industrial policies refer to a series of policies using which the government intervenes in resource allocation and benefits distribution, restricts (compulsory), induces (incentives) corporate behavior, and influences the direction of industrial development"
(Atkinson, 2021), p. 0	"a set of policies and programs explicitly designed to support specific targeted industries and technologies."
(Cherif et al., 2022)	"typically justified by the presence of sector-specific externalities, where the benefits of addressing them outweigh the costs and risks of the proposed intervention."
(Criscuolo et al., 2022) p. 4	"interventions intended to improve structurally the performance of the domestic business sector"
(Coulter, 2022)	"A programme of govt. intervention that aims to improve the business environment, or alter the structure of the economy towards sectors or technologies that offer better prospects for growth or improving societal welfare"
(Juhász et al., 2022)	"Industrial policy is goal oriented state action. The purpose is to shape the composition of economic activity. Specifically: industrial policy seeks to change the relative prices across sectors or direct resources towards certain selectively targeted activities (e.g., exporting, R&D), with the purpose of shifting the long-run composition"
(DiPippo et al., 2022)	"industrial policy is defined as any state intervention—whether explicit or implicit—that aims to reallocate resources to support certain firms or sectors to achieve one or more policy objectives. This definition is narrow in the sense that it excludes most "horizontal" policies, which are meant to help strengthen an economy's fundamental foundations and the overall competitiveness of business."
(Agarwal, 2023)	"Industrial policy refers to a set of policies that governments use to bolster national industries or companies deemed strategically important for economic competitiveness, social outcomes, or national security"; "government efforts to shape the economy by targeting specific industries, firms, or economic activities."
(EU general principles, 2023)	"Industrial policy is cross-cutting in nature and aims to secure framework conditions favourable to industrial competitiveness."
(Pineli et al., 2023)	"Ip role is changing the structure of an economy in either direction, magnitude, or speed, in a way that market forces alone would not be able to achieve"
(Kastelli et al., 2023)	"Industrialization [policy] that drives development along the three aspects of inclusion, sustainability, and resilience"
(Juhász et al., 2023)	"Those government policies that explicitly target the transformation of the structure of economic activity in pursuit of some public goal."

Source: (Aiginger, 2007) and own elaboration, based on cited references.

Annex 2
Selected countries industrial strategies

This Annex provides a more elaborate discussion of the country industrial strategies considered in the main text. A wide range of instruments and policies have been proposed to achieve the broad set of objectives of the reviewed countries' industrial strategies. Different weights are given to different policy instruments depending on the country under consideration and their development level. While public financing is relevant across countries, the extent to which countries rely upon this approach differs widely. Issues around regulations and standards that help define the framework conditions also differ across countries, being highly relevant in the EU but less so in other countries.

The example of the USA is instructive in highlighting the range of policies and instruments put forward in recent strategies. Policies and instruments to encourage the energy transition and to direct technical change are wide-ranging. These include the actions of the Advanced Research Projects Agency-Energy (ARPA-E) which has expanded renewable energy programs, advanced manufacturing institutes, introduced a Loan Programs Office for financing new energy technology projects and Energy Frontier Research Centers to support basic research in new technology areas and energy Hubs to promote applied R&D in key technology fields. In response to this, a network of manufacturing innovation institutes called Manufacturing USA have been developed, supported by the departments of Defense, Energy, and Commerce (through its National Institute of Standards and Technology (NIST)), with each of these institutes being organized around a particular advanced manufacturing technology, ranging from 3D printing to photonics, digital production, and robotics. Through such initiatives the intention is to accelerate the introduction of productivity-enhancing manufacturing technologies and to enable the United States to better compete in a collaborative model to bring together industry and universities. In this sense, the approach targets the entire innovation system, seeking to improve the efficiency of the system. Related initiatives in this area include those associated with the Endless Frontier Act of 2021, which established a Directorate for Technology and Innovation in the National Science Foundation (NSF) that allows for the extension of the Manufacturing USA Program and the expansion of the program to support innovation and growth in domestic manufacturing.

The example of the Endless Frontier Act further highlights how particular strategies seek to achieve multiple objectives. As already highlighted, the Act has a focus on technologies rather than industries, with the Act providing a formal body to: fund applied and translational research; encourage university-industry partnerships to accelerate R&D and commercialization of critical technologies; develop Test Beds to advance the development, demonstration, and deployment of new technologies; advance the Manufacturing USA Institutes, giving them responsibility for production technology development and expanded capacity for education and workforce development; and extend the Manufacturing Extension Partnership (MEP) program to assist small manufacturers. The Act further has objectives related to regional development and the reduction of regional inequalities, and thus also provides for Regional Technology Hubs focusing on technology development and improving regional innovation capacity alongside the Recompete Pilot Program to support persistently distressed communities with economic development activities.

Other aspects of recent industrial strategy in the US adopt more traditional approaches to industrial policies and tools. The CHIPS and Science Act, for example, identifies various policy instruments including the direct support of production facilities; tax credits; loan guarantee programs; education programs to support workforce development; grants to construct, expand, and modernize domestic facilities and equipment for semiconductor fabrication, assembly, testing, advanced packaging, or research and development; investment tax credits and loan guarantee programs for advanced production facilities; and investment in research and development, including the establishment of several public-private partnerships and government-industry-university centres and programs to strengthen US capabilities across the sector; among others.

Combining a mixture of traditional and more recent and novel instruments, the 2022 Inflation Reduction Act is the largest public investment in infrastructure, social and environmental programs in the US since the 1930s, highlighting the significant role of public funding in many recent industrial strategies. A major pillar of this Act relates to domestic energy production and specifically the creation of incentives to develop, produce and purchase green technologies, with a range of tax and consumer incentives introduced. On the production side, incentives are provided to invest in clean energy, transportation, and manufacturing, with funds being delivered through a mix of tax incentives, grants, and loan guarantees, and to undertake investment in new climate-related technology development.

The EU's New Industrial Strategy for Europe is somewhat less explicit on the instruments and resources that will be used to achieve the objectives of the EU's strategy, reflecting the fact that policy in this realm is split between the European Commission and governments of nation states. As such, the strategy sets the agenda and the direction of travel but leaves space for individual countries in how to achieve the agenda. Relatedly, the instruments that are highlighted in the strategy often link to issues of regulation, standardisation, and certification. The strategy highlights that a major benefit of the EU's single market is that it provides a common regulatory space that can facilitate competitiveness, further arguing that the single market relies on well-functioning systems for standardisation and certification, and in the digital context —though also more broadly— intellectual property rights protection. The strategy also highlights the independent EU competition policy as a means of levelling the playing field and, in turn, as a driver of innovation. The strategy thus highlights the need to develop new standards and technical regulations, and to ensure that policies related to intellectual property rights and competition are relevant and fit for purpose. Ensuring a level playing field and reducing barriers in international markets is a further approach highlighted by the strategy, with the strategy discussing the need to keep markets open through trade deals while addressing the distortive effects of foreign subsidies and issues with reciprocity in procurement rules, specifically the lack of access for European firms to the home markets of foreign, state-owned companies.

Beyond issues of regulations, standards and legislation, the strategy highlights the need for innovation and new technologies to meet, among other objectives, environmental targets. The EU Emissions Trading System Innovation Fund is envisaged as a means of developing large-scale innovative projects to support clean products in energy-intensive sectors. In addition to innovation, the strategy highlights the need for planning and investment in low-carbon generation technologies, capacity, and infrastructure. This will involve a more effective use of all carriers of energy, with the use of trans-European energy networks supporting the transition to climate neutrality.

More broadly, the strategy highlights the importance of frontier science and technology as a means of achieving the twin transition. As such, the strategy highlights the need to invest in disruptive and breakthrough research and innovation. Policies are therefore envisaged to be "innovation-conducive", while individual sectors are given the freedom to define their own roadmaps for climate-neutrality and digital leadership. The strategy envisages Public-Private Partnerships to achieve this, especially given the constraints on public finances. EU programmes are also considered a means of encouraging appropriate investment and innovation, with Horizon Europe, the Digital Europe Programme, the Single Market Programme, the Innovation Fund, InvestEU, the European Social Fund, the European Defence Fund and the EU Space Programme, and all European Structural and Investment funds being considered as means to help promote the competitiveness of EU industry. The recently established European Innovation Council is also given the remit to "identify next generation technologies, accelerate their commercial application and help them support the rapid scale up of start-ups."

The EU's industrial strategy further highlights the importance of strategic autonomy, with regulations and investment being the two major means of achieving this. In this context, additional regulations on the screening of foreign direct investment were introduced in 2020 to "safeguard Europe's interests on the grounds of security and public order." Beyond this, the strategy highlights

several policies and interventions relevant to specific sectors or technologies. One example is the development of Quantum Communication Infrastructure, while focus will also be put on key enabling technologies, such as robotics, microelectronics, high-performance computing, data cloud infrastructure, blockchain, quantum technologies, photonics, industrial biotechnology, biomedicine, nanotechnologies, pharmaceuticals, and advanced materials and technologies, that are strategically important. Arguing that the European defence and space sectors are essential for Europe's future, the strategy further highlights the role of the European Defence Fund to help build an integrated defence industrial base. Building upon research on the defence industry in alternative settings, the strategy envisages a role for defence and space industries in generating technologies that are widely applicable, with the development of synergies between civil, space and defence industries in EU programmes, resulting in the more effective use of resources and technologies. Beyond these industries, the strategy further highlights the need for strategic autonomy in the context of non-energy raw materials (where increased recycling is considered a strategy to reduce dependency on other countries) and access to medical products and pharmaceuticals.

In line with an important set of instruments in the case of the US And EU, the role of public investment is central in the Republic of Korea's New Deal. The main instrument to achieve the different objectives involves large-scale public investments that are largely targeted at the development of infrastructure for digital and green transitions, as well as encouraging innovation, supporting firms' investments, and investing in job training, education programs, and the development of a universal unemployment insurance system.

Public investment is also an important component of the Thailand 4.0 strategy. To achieve the aim of developing Industry 4.0 sectors, the Thai strategy involves the targeting of ten industries that were selected with the intention that they serve as new and more sustainable growth engines. These include five industries that have a foothold and are already connected to existing industries within Thailand (new-generation automotive; smart electronics; affluent, medical and wellness tourism; agriculture and biotechnology; food for the future) and five that have little or no footprint but that are intended to become significant long-term growth drivers (manufacturing robotics; medical hub; aviation and logistics; biofuels and biochemicals; digital industries). Beyond the sectoral focus, the development of the Eastern Economic Corridor (EEC) —the newest special economic zone— has been identified as one means to achieve the strategy. Specifically, the strategy involves the encouragement of investment in the EEC as an important component to develop new industries and agglomerations. To achieve this, the Thai government has invested heavily in infrastructure to enhance the connectivity of the three provinces in the EEC with the rest of the world. Air transport and cargo capacities are also being enhanced substantially, with the intention to further invest in high-speed and double-track railways. Beyond physical infrastructure, the strategy involves the establishment of EEC Offices that serve as one stop service centres in three locations to simplify regulatory processes, by handling applications for permissions and licenses necessary for business operation in the EEC. The package of policies further includes income tax holidays, reduced personal income tax rates, and reductions in corporate tax rates, as well as exemptions and other benefits including long-term land leases, exemptions from import duties and work visas, for those investing in the EEC.

The strategy of China highlights several approaches, with financing being a key factor underpinning these. The approaches include being innovation driven and promoting cross-field and cross-industry collaboration; improving the institutional environment through a system of legislation and standards; identifying innovations in key general-purpose technologies; promoting a digitized, networked, and intelligent manufacturing industry; emphasising quality as the building block for successful manufacturing; and incubating independent brands. To achieve these, financial support is

often considered key.[42] State-owned banks play an important role in providing subsidies, low-interest loans, and bonds, while various funds exist to assist in upgrading technology in specific key industries. As a means of generating indigenous intellectual property, much of this funding is linked to the use of local intellectual property. Targets for firms have also been introduced, particularly related to research and development spending, as well as labour productivity and energy and water consumption. Efforts to increase brand awareness as a means of improving international competitiveness have also been undertaken, whilst investments in improvements in quality control technology and management mechanisms, among others, are intended to improve product quality. Beyond these, reforms of institutions and the creation of a fair and competitive market environment are considered important means of achieving the strategies' objectives.

In the case of the UAE, the strategy highlights other instruments that are perhaps more relevant to countries at lower levels of development. One aspect of this is the need to accelerate advanced technology adoption, with the use of value chains suggested as a means to achieve this, in addition to efforts to cultivate a culture of innovation. The strategy further highlights a set of focal sectors including Food, Pharmaceuticals, Electrical equipment and electronics, Advanced manufacturing, Petrochemicals and chemical products, Rubber and plastics, Machinery and equipment, Hydrogen, Medical technology, and Space technology. To achieve the broad aims of Operation 300bn, the strategy suggests a mix of traditional and more recent instruments, envisaging expanding the number of trade agreements; reforming and modernizing industrial laws, lowering energy costs for industry, providing flexible financing at competitive costs for priority sectors, undertaking a digital transformation, and simplifying registration, licensing, and fee procedures.

Review of selected countries objectives and rationales

An initial observation when considering the rationales and objectives laid out in the recent country strategies reviewed is that the rationales for industrial policy are often not explicit in the documents and/or what we call objectives in this study are considered rationales in many of the recent strategies. In other words, rather than highlighting why public policy interventions may be needed, the strategies focus on various objectives, including major global challenges, as the main rationale for the strategy being adopted.

In the case of the US, a broad range of rationales and objectives have driven the development of the varied strategies implemented.[43] Societal challenges and strategic autonomy are often the focus of recent strategies. In terms of societal challenges, the major focus is on environmental sustainability and specifically the goal of mitigating climate change through energy innovation. This is an important component of the Bipartisan Infrastructure Deal[44] in the US. While the overall ambition of this strategy, agreed in 2021, is to upgrade the nation's infrastructure and improve competitiveness, environmental sustainability is an important objective of the deal. Efforts to improve transport infrastructure will focus on improving environmental sustainability through improvements in infrastructures such as EV chargers, upgrading the power infrastructure and improving the public transport system.

Climate change and environmental degradation are also one of the major pillars of the European Union's recent policy initiatives, through its European Green Deal.[45] The objective of this initiative is to transform the EU into a "modern, resource-efficient and competitive economy", with the ambition of

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42 https://isdp.eu/content/uploads/2018/06/Made-in-China-Backgrounder.pdf.

43 In recent times, these include US Operation Warp Speed to encourage rapid vaccine development, the CHIPS Act to rebuild US technology capability in semiconductor manufacturing, the Infrastructure Act of 2021 which included major energy technology demonstrations, an executive branch initiative on Building Resilient Supply Chains to improve supply chains in critical technology areas), and the Inflation Reduction Act that has a large component of $378 billion for implementing climate-related energy technologies.

44 https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/.

45 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.

reaching net zero greenhouse gas emissions by 2050 and to decouple economic growth from resource use. Looking beyond the US and EU, rationales and objectives linked to climate change and sustainability are often present in industrial strategies but tend not to be the focus. In the case of the Republic of Korea, for example, their recent strategy (The Korean New Deal) includes a component highlighting the need to build eco-friendly energy infrastructures that promote energy saving, to increase the use of renewable energy, and to develop green clusters, but the priority areas of the strategy are elsewhere. This is also true in the United Arab Emirates (UAE), with its latest Operation 300bn strategy mentioning the need to deploy clean energy solutions, to promote responsible consumption and production, and to adopt green and sustainable manufacturing, though the main objectives of the strategy remain largely economic. This is also the case for a couple of strategies that were developed before the Covid-19 pandemic in Thailand: in the Thailand 4.0 strategy the importance of green technologies and sustainability is mentioned, but the focus is on digital technologies; in the Thai National Strategy 2018-2037, on the other hand, while green issues are somewhat more central, they remain far less central than in the EU and the United States. Similarly, the Made in China 2025 initiative highlights concerns around energy utilisation and environmental pollution, but these issues are not central to the strategy. The strategy does have as an objective green development, however, which is suggested as a means of combating climate change and the environmental and health impacts of China's industrialisation. In this spirit, the strategy promotes sustainable development and the promotion and application of energy-saving and environmental protection technologies, processes, and equipment, as well as the full implementation of clean production, with special emphasis on the need to develop a circular economy, improve resource recycling efficiency, build a green manufacturing system, and take the development path of ecological civilization. It is highlighted that to achieve this objective, it is important to increase R&D in advanced energy-saving and environmental protection technologies, as well as to promote low-carbon production and recycling in order to use resources more efficiently.

Beyond the climate goal, various other societal challenges and aspects are present in the various strategies, with efforts to reduce inequality featuring in many strategies. In the US, issues of equality are present in the Inflation Reduction Act, for example, which includes aspects related to increased equity in the provision of health care. They are further present in the Bipartisan Infrastructure Deal, which includes objectives related to access to clean water and reliable high-speed internet. In the EU, the Green Deal has the objective of ensuring that "no person and no place" is left behind. This latter example also highlights the objective of regional disparities, something also considered in the US Endless Frontier Act which gives the Department of Commerce the task of designating regional technology hubs to facilitate activities supporting regional economic development that diffuses innovation across the country, and that awards grants to facilitate the development of regional technology strategies. Relatedly, the Korean New Deal emphasises policies to strengthen employment and social safety nets as a means of building resilience of the population to uncertainty. Specifically, the strategy highlights the need to develop low-skilled jobs as well as jobs that target the new economy —i.e., the digital and green economy— as a means of avoiding a further polarization of the labour market. The strategy further proposes the introduction of a universal unemployment insurance system to provide an appropriate social safety net for the population.

While discussions around the importance of developing strategic autonomy are recent, rising particularly during and in the aftermath of the Covid-19 pandemic and the resulting supply chain disruptions, such concerns also appear in earlier strategies. The Made in China 2025 strategy, for example, highlights concern over the extent to which the industrial sector in China is dependent on foreign countries for key technologies and "high-end equipment", emphasising the need for a transformation of industry to upgrade and encourage higher quality production. Building upon these arguments, the strategy has the goal of increasing the domestic content of core components and materials to 70 percent by 2025, and generally reducing its dependence on foreign technologies.

In more recent strategies, and particular those of the EU and US, strategic autonomy is often framed in the context of a perceived need to build resilience and vertical integration within supply chains, both because of the effects and aftermath of the Covid-19 pandemic and the rise of China. In the US, various provisions within the Inflation Reduction Act and the Endless Frontier Act within the US are concerned with strengthening domestic supply chains, particularly in certain sectors such as critical minerals. The CHIPS and Science Act of 2022[46] has something of a more traditional objective for industrial policy, namely revitalizing domestic manufacturing, creating good-paying local jobs, and strengthening American supply chains, with a further ambition to accelerate the industries of the future (including artificial intelligence, biotechnology, and computing). Also consistent with more traditional arguments for industrial policy and government intervention, however, the CHIPS Act further links manufacturing capacity to issues of national security, with a focus on defence technologies and systems and for upcoming generations of advanced technologies, particularly artificial intelligence and quantum computing which also have significant national security dimensions. In this sense, the strong focus on semi-conductors, with nearly $53bn of funding for research development, manufacturing, and workforce development, is also linked to issues of national security and strategic autonomy in the production of critical technologies, as well as the development of leadership in such technologies and the creation of manufacturing jobs.

Concerns around strategic autonomy are also a component of the EU's current industrial strategies. While focusing on the twin (green and digital) transition, the new industrial strategy further highlights more strategic concerns around the sovereignty of Europe and the need to ensure a level playing field in a world of "moving geopolitical plates". More specifically, the strategy emphasises the need for strategic autonomy and the need to reduce dependence on others for things that the "EU most needs", including critical materials and technologies, food, infrastructure, and security. Developing autonomy in such areas is also considered an opportunity for EU industry to develop "its own markets, products and services which boost competitiveness."

Strategic autonomy is further a concern in countries at lower levels of development, though the resulting objectives may take different forms. In the case of the UAE, for example, the strategy highlights the need to develop strategic autonomy, but in doing so focuses on attracting talent and increasing the skills of the workforce.

Beyond these two objectives of societal challenges and strategic autonomy, the traditional view of industrial strategy as having primarily economic objectives looms large in recent strategies. The CHIPS and Science Act in the US, for example, has the objectives of revitalizing domestic manufacturing, creating good-paying local jobs, and strengthening American supply chains, with additional objectives in US strategies relating to the traditional industrial policy goal of competitiveness, and specifically meeting the competitiveness challenge with regard to the rise of China in manufacturing.

Economic objectives are also a feature of the Made in China 2025 (MIC) initiative[47] that was introduced in 2015 and is focussed heavily on modernising China's industrial capability. Although China is a successful manufacturing country in terms of the scale of its activity, the strategy acknowledges that the industrial sector is not strong, with gaps in indigenous innovation capabilities, the efficiency of resource utilisation, the structure of industry, and the quality of the sector (with few "world-renowned brands"). Maintaining competitiveness is a key objective for the strategy, with concerns that China faces competition from two sides —developed countries that are looking to re-industrialise and low-cost developing country producers such as Vietnam.

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[46] https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create -jobs-strengthen-supply-chains-and-counter-china/.

[47] https://cset.georgetown.edu/wp-content/uploads/t0432_made_in_china_2025_EN.pdf.

In terms of further economic objectives, an important objective of the strategy is the development and improvement of local innovation capabilities, with the intention being to remove China's reliance on imported technology. Relatedly, the need to develop Chinese companies that are locally and globally competitive is highlighted, with a focus on improving the quality of production through technological innovation. Smart manufacturing, involving the use of cyber-physical systems, such as intelligent equipment and smart factories, is further emphasised as a mean of "leading the transformation of manufacturing methods; network crowdsourcing, collaborative design, mass customization, precise supply chain management, total life cycle management, and e-commerce".

The strategy further highlights the role of structural change and specifically "structural optimization", with the need for structural change to develop advanced manufacturing, to transform and upgrade traditional industries, and to "promote the transformation of production-oriented manufacturing to service-oriented manufacturing". Issues of structural transformation are also common in the strategies of other countries. In the case of the EU, for example, the New Industrial Strategy for Europe[48] describes how the twin transitions can be achieved through industrial policy, highlighting the need for substantial structural change, with new technologies creating new business models and the development of new areas of production and work, with examples including artificial intelligence, 5G, data and metadata analytics. Structural Change also appears in the Thai National Strategy 2018-2037[49], which is founded upon three main pillars: Security, Prosperity, and Sustainability. While this strategy is far broader than an industrial strategy (including national security, maintaining domestic peace, and social cohesion, among others), the strategy highlights policies to achieve structural transformation (e.g., developing agriculture and tourism as well as future manufacturing and services), developing the conditions for production including infrastructure development and investments in human capital, and developing framework conditions (notably through improving access to markets, information, and finance). Generating growth that is sustainable is a further important aspect of the broader strategy.

Economic objectives also feature prominently in the other industrial strategies. The Korean New Deal, finalised in 2020, has several objectives including economic objectives related to creating new markets and demand, accelerating innovation and investment by the private sector, and achieving structural transformation. This strategy highlights the need to use the data driven economy to generate new industries and to lead to structural change towards key industries, specifically the so-called 'untact' (non-contact or face to face) industries. In the case of the UAE's Operation 300bn the major objective is to increase the country's GDP to AED 300bn by 2031, with the strategy further seeking to enhance competitiveness through the development of an attractive business environment to support the growth of national industries and to boost economic growth through productivity improvements and increased employment.

Digitalisation is a cross-cutting issue, which links to objectives regarding societal challenges, strategic autonomy, and economic objectives. Digitalisation further links to ideas about directed technical change and structural transformation. It is also an objective that appears across different strategy documents, largely regardless of development levels. In the case of the EU, for example, the second major pillar of the EU's recent strategy is the digital economy and its Strategy on Shaping Europe's Digital Future[50]. This strategy envisages the EU as a global leader in the digital economy, specifically by being a global role model, by supporting developing economies in their digitalization efforts, and by developing digital standards. The strategy itself is based around three pillars: (i) technology that works for the people – involving issues of developing digital skills, protecting people

[48] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/shaping-europes-digital-future_en.
[49] https://www.bic.moe.go.th/images/stories/pdf/National_Strategy_Summary.pdf.
[50] https://digital-strategy.ec.europa.eu/en.

from digital threats, and expanding ultra-fast broadband and super-computing capacity; (ii) a fair and competitive digital economy —by enabling innovation and entrepreneurship through increasing access to finance, by creating and clarifying appropriate rules for the digital economy, and by increasing access to high-quality data while protecting personal and sensitive data; and (iii) an open, democratic and sustainable society —by using digital technologies in the EU's efforts to be climate neutral by 2050, by reducing the digital sector's carbon emissions, and by giving citizens more control over their data and fighting disinformation.

Issues of digitalisation are central in Thailand's 20-year strategy known as Thailand 4.0 that was agreed in 2018. The major objectives of the Thailand 4.0 policy are to promote and support innovation, creativity, research and development, and high-tech production, with a particular emphasis on the development of Industry 4.0, a term used to describe the digital transformation of manufacturing. Issues of digitalisation are also central in the case of China's Made in China 2025 strategy. The strategy, which relies heavily on intelligent manufacturing is similar in spirit to other industrial strategies, such as those in Germany and Japan as well as the Thailand 4.0 strategy discussed above. In its efforts to adopt and benefit from Industry 4.0 the strategy highlights the role of information technology in "forming new production methods, industrial forms, business models, and economic growth points" and of the role of technologies such as "3D printing, mobile internet, cloud computing, big data, bioengineering, new energy, and new materials". The emphasis is on the development of key technologies and sectors linked to Industry 4.0, with ten strategic sectors/technologies identified[51]: new information technology, numerical control tools, aerospace equipment, high-tech ships, railway equipment, energy saving, new materials, medical devices, agricultural machinery, and power equipment. Digitalisation is further an important component of the Korean New Deal, which has several objectives including the building of data infrastructures for digitalization and the creation of smart factories.

The focus on issues of digitalisation link strongly to more general objectives and rationales around directed technical change. Indeed, the focus on the twin —digital and green— transition in many strategies can often be framed as a means of public policy being used to direct technical change in the economy. In some cases, such efforts at directed technical change are more explicit, with the Endless Frontier Act of 2021 in the US establishing a Directorate for Technology and Innovation as a means of expanding and directing innovation efforts, with further objectives being to accelerate the industries of the future (including artificial intelligence, biotechnology, and computing).

As a final objective, an important aspect of industrial policy in the EU can be linked to developing framework conditions. The New Industrial Strategy for Europe highlights the strength and role of the European Union as an enabler and regulator, with an important role of the EU being to set the framework and provide political and policy direction as a means of generating certainty for investors and for innovation (Comisión Europea, 2020). Coordination is further highlighted as an important rationale for the strategy, with the European Commission ready to "co-design and co-create solutions" with industry, social partners, and other stakeholders. The strategy further talks of a focus on industrial ecosystems, highlighting the systemic nature of the approach to industrial policy.

The discussion of country strategies objectives and rationales provides a limited and highly selective review of recent industrial policy strategies. Despite this, they provide some useful insights, summarised as follows:

- The rationales for industrial policy are often not explicit in the industrial strategies, with objectives often considered as rationales. Despite this, several rationales can be identified in the policy documents. A rationale that is common to many of the strategies considered is directed technical change, particularly in the context of the digital and green transitions.

[51] https://isdp.eu/content/uploads/2018/06/Made-in-China-Backgrounder.pdf.

Relatedly, structural transformation is considered a rationale in many cases and perhaps most explicitly in the case of China, which envisages a shift within manufacturing towards advanced manufacturing sectors and within sectors towards higher quality production. The creation of the conditions for production is an important rationale in many cases, particularly regarding infrastructure investments and to the creation of demand (e.g., for green goods). The development of framework conditions is less explicit in many of the strategies, with the notable exception of the EU, which has a strong focus on regulations, standards, and certification. While the coordination of activities is implicit in some of the strategies it is perhaps less emphasised than others, both in general but also in terms of how such coordination will be organised.

- The various strategies examined do often highlight the importance of sectors and the need to develop certain sectors, particularly advanced manufacturing sectors. At the same time, it could be argued that the emphasis in recent strategies tends to be more strongly on technologies and products rather than sectors, which can either represent a focus on certain segments within broader sectors (e.g., electric vehicles) or technologies of a cross-cutting nature (e.g., AI and machine learning). Technologies related to the digital transition (e.g., broadband access, quantum computing) and the green transition (e.g., electric vehicles, charging stations, carbon capture) have also often being the focus of recent strategies.

Annex 3
Search queries

	Query string in Title and Abstract	Years	Fields of research	Publication type	Hits
Q1	("industrial polic*") AND ((innovation) OR (productivity) OR (competitiveness) OR (growth))	[2013, 2023]	44 Human Society; 38 Economics; 35 Commerce, Management, Tourism	Article; Chapter; Preprint	1 866
Q2	("industrial polic*") AND (("sustainable development") OR (SDG*) OR (sustainab*) OR (green) OR (climate))	[2013, 2023]	45 Human Society; 38 Economics; 35 Commerce, Management, Tourism	Article; Chapter; Preprint	652
Q3	("industrial polic*") AND ((resilience) OR ("artificial intelligence") OR ("covid-19") or ("strategic autonomy"))	[2013, 2023]	46 Human Society; 38 Economics; 35 Commerce, Management, Tourism	Article; Chapter; Preprint	354
Q4	("industrial polic*") AND ((instruments) OR (design) OR (rationales) OR (implementation) OR (evaluation) OR (effectiveness))	[2013, 2023]	46 Human Society; 38 Economics; 35 Commerce, Management, Tourism	Article; Chapter; Preprint	1 021
Q5	("industrial strateg*") AND ((sector) OR (technolog*) OR (mission*) OR (place*) OR (specialization))	[2013, 2023]	46 Human Society; 38 Economics; 35 Commerce, Management, Tourism	Article; Chapter; Preprint	176
				Total	2 887

Source: Authors' elaboration.

Annex 4
List of references included in the systematic review

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This report documents global shifts in of industrial policy objectives and the rationales behind public intervention to address them. Drawing from a selected sample of policy documents from international organizations and countries with literature on innovation and technical change, this report presents a classification of objectives and rationales. This classification is used to code systematically the academic literature on industrial policy to analyse changes in objectives and rationales in publications on countries of different income groups. The findings show increased attention to social challenges with respect to economic objectives, especially in lower-income countries, while in high-income countries the shift is towards strategic objectives. There has, however, been limited change in rationales. There is also greater coherence between objectives and rationales for policy intervention in the discussion on specific instruments. Based on this evidence, it is suggested that more careful analysis of the rationales for public intervention is needed within existing frameworks and strategic thinking on industrial policies with a view to designing industrial strategies that are time consistent and systematically take into account the synergies and tensions between objectives.

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